VW 910/ 921

Advanced Programmable Flight Data Computer

User's Manual

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Contents

) The Menu-position „3/2" meant, that on the computer-display the menu-row 3 is selected for to the Menu-selector rotary switch Position 2 (Matrix-column 2) **...14**

1.   System Overview

The core of the Variometer is wholly and newly developed
absolute and differential pressure sensor.
It consists of two metal membranes adjacent to each other
which produce travel proportional to pressure. The travel is
measured using semiconductors which react to the magnetic
field.
The sensor produces a voltage signal proportional to this travel
in a bridge circuit. The signal is up to 100 times stronger than

that of the sensors currently available, resulting in reduced interference, more stable zeroing and excellent reliability.

The membranes are adjacent to each other, and so compensate for any travel resulting from accelerations and prevent corruption of the signal. We have developed these sensors ourselves so they are not available in any other vario system (Patent No: P3023719.5-09).

The Variometer signal is derived from the absolute pressure sensor which produces the altitude signal using electronic differentiation.
A second sensor provides the pitot pressure signal, by measuring the reduction of pressure in accordance with the barometric pressure altitude formula. To ensure that error free compensation is maintained, the altitude signal corrects the pitot pressure signal value. This means that compensation is achieved without a total-energy-compensation jet and is exact at any altitude.

An electronic filter with a time constant of 1.2 seconds smoothes out both the Variometer display and also the audio Variometer output
(dual tone audio vario).

2.   Description of Controls

2.1   VW910 Variometer   (see Fig. 1)

(1)   On-Off /Volume knob

(2)   Compensation +/-

(3)   Zero setting (without audio signal)

2.2   VW921 Flight Data Computer

(4)   10 position, rotary Menu selector switch

(5)   MC (MacCready) Value selector rotary switch
        from 0.0 to 5.0 in steps of 0.5

(6)   Wind Component selector rotary switch
        from - 25 knots/h to +25 knots/h in 2.5 knots/ h-steps.

(7)   Polar Selector Switch
        P1 Bug contaminated polar
        P0 Measured polar
        P2 Rain polar

(8)   Flight mode (Speed-to-fly) Menu selector switch
        'S'   :   Thermal(climb) / Statistics
mode
        Mid position   :   Cruise mode
        'EA'   :   Final Glide mode

(9)   Input toggle switch **'+/– '**
        Function 1:   Moving the cursor between Display lines.

Function 2:   Increasing / reducing of correction values.

(10)   Enter and Correction toggle switch
      'KORR'   **:** Entry of a correction action
      'ENT'   **:** Entry of the corrected value

(11)   Electric vario zeroing (screwdriver adjustment for dial instrument and audio).

(12)   Selection of polar (see Appendix 9.1)

3.   Operation

3.1   Powering up the instrument

After Power-On (1) set-up the following one after the other:

3.1.1   The VW910 Variometer

If the **Flight-mode** Menu selector switch (8) is on **S** "Statistic/Thermal" position, the indicator will deflect fully counter-clockwise and subsequently home in on zero in about 20-30 seconds.

If the **Flight-mode** Menu selector switch (8) is in mid position (Cruise mode), there will be a deflection of the pointer into the minus-sector, depending on the MC-value and the Polar.

The audio-signal also behaves similarly.

3.1.2   The VW921 Flight Data Computer

On the Display the following appears for about 10 seconds

```
VW921      DG 100
Version: 34   1.4US
```

On the first row of the display beside the Flight Data Computer model (VW921) your glider model should be displayed (or a type with a similar Polar). A correct Polar selection is a requisite for the proper function of the Cross country mode and the final-glide-mode calculation! If a change is required to the Polar selection, e.g. a wingspan change with Winglets, you can make the change only in the initial 10 seconds. You enter the correction-mode by pressing the 'KORR'-switch (10)

within the 10 sec. time-window (to select the glider model, See paragraph 7.4.).

The second display row displays your flight computer version. The double digit number shows your version. The two digit number is determined by the configuration as follows:

Basic flight computer with single row display   00

Option	Value
double row Display	+10
Temperature-sensor	+01
Compass-linkage	+02
Statistics	+04
GPS-linkage	+20
ISO country code (for U.S.A. model)	US

For example the configuration-figure of '34' agrees therefore, with US version with the options double row display, statistics and GPS-linkage, but without compass and without temperature-sensor.

The letter '1.4' shows the software version of your flight computer-software followed by the ISO country code (for USA is US).

Following the initial display, the upper right display quadrant will display the current values for the following in 3 second intervals:

MC   (**McC**ready-value)
WD   (**WinD**-component)
WL   (**W**ing **L**oading)

Now you may adjust (1) for acceptable loudness. Then the MC-value (5) for null. The actual Wing Loading (including water-ballast) (Menu-position of '0-10,' correction-procedure) and the wind-component (6) likewise to null.

In the second row set all switches (7-10) in the center position.

For extensive and clearly arranged information the display is divided into quadrants each with 8 digits.

Top-left	top-right
bottom-left	bottom-right

While the top-left quadrant of the display always shows the variometer reading as a function of the flight mode selector switch position or respectively of the flaps position sensor. The information in the 3 other display quadrants depends on the display mode selected.
You have basically three different menu-options to select the information to be displayed (8):

1.) the Normal- or cross-country mode
       - switch (8) in center position
       - menu-page "position selection of the VW921"
       - see section 3.3. "The normal or cross country mode"

2.) the statistics-mode
       - switch(8) up position ('**S**')
       - menu-page "position selection of the VW921-statistics"
       - see section 3.4. "The statistics-mood"

3.) the final-glide-mood
       - switch(8) down position ('**EA**')
       - fixed final glide side
       - see section 3.5. "The final-glide-mood"

3.2   The Variometer Data

The functions "Thermal" and "Cruise" are chosen either by the pilot with the SG-switch or by the installed magnet-switch on the flap push-rod. (see Chapter 6.1. Installation)

In the first case, "Thermal" and "Cruise", shows the **Variometer** (round-indicator) momentary climb- or sink-rate. The display range is of ± 15.0 feet/sec., the acoustic range is of ± 30.0 feet/sec. At sink-rates higher than -30.0 feet/sec. the tone

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abandons completely. This is not a Variometer error, but a warning in an extreme flight-situation (for example during a wave-flight).

On the top left field of the **flight computer** display the averaged climb during the last 20 seconds is displayed:

```
M: + 2.4  xxxxxxx
 xxxxxxx  xxxxxxx
```

Current standards in competition flying make a digital display with this type of information necessary. An improvement of only 0.2 knots in average rate of climb during a 300 km flight means a gain of about 7 minutes. An analog display cannot provide the same degree of accuracy.

In the second case, "cruise/speed-to-fly", the speed-to-fly is represented visually by the variometer and acoustically by the audio variometer.

If the variometer reading and the audio tone are:
· in the minus range: fly faster,
· in the plus range: fly slower

You are flying at the optimum speed when zero is displayed and the audio tone is intermittent. We have intentionally not left a window of silence around the optimum speed-to-fly. The pilot would not know whether he should fly faster or slower if there was a "window" of silence. This would apply no matter how narrow the window of silence.

Needless to say, speed-to-fly is related to the MacCready value set and also to Wing Loading. You can check the MC-value on the control knob position or you can easily turn the sensor knob (5) slightly and for three seconds the MC-value is displayed in the top-right quadrant.

```
xxxxxxx        MC: 1.5
xxxxxxx     xxxxxxx
```

It is important when you are making the selections with the rotary switch that you are sure that it is latched otherwise the computer does not know which of the two values to display and will alternate between the two.

The Wing Loading selection performed at the +10 position of the Menu-selector knob (4)

```
C: +0.0    -><-  0/ 10
WL: 32.5
```

- · press the toggle-switch (10) to '**KORR**' position,

- · with the '**+/-**' toggle-switch (9) change the value,

- · press the toggle-switch (10) to '**ENT** ', to enter the value.

So that you have an indication of the vertical speed of air masses independent of the speed-to-fly, the computer offers a digital readout of **Net Climb** and **Net Sink**. That is the rate of climb and sink of the air mass through which you are flying at the time, without taking into account the glider's rate of sink.

```
N: +3.0    xxxxxxx
xxxxxxx   xxxxxxx
```

A net reading of + 3.0 knots means that your glider will
actually climb at approximately 2.0 knots should you decide to
circle in this particular air mass.
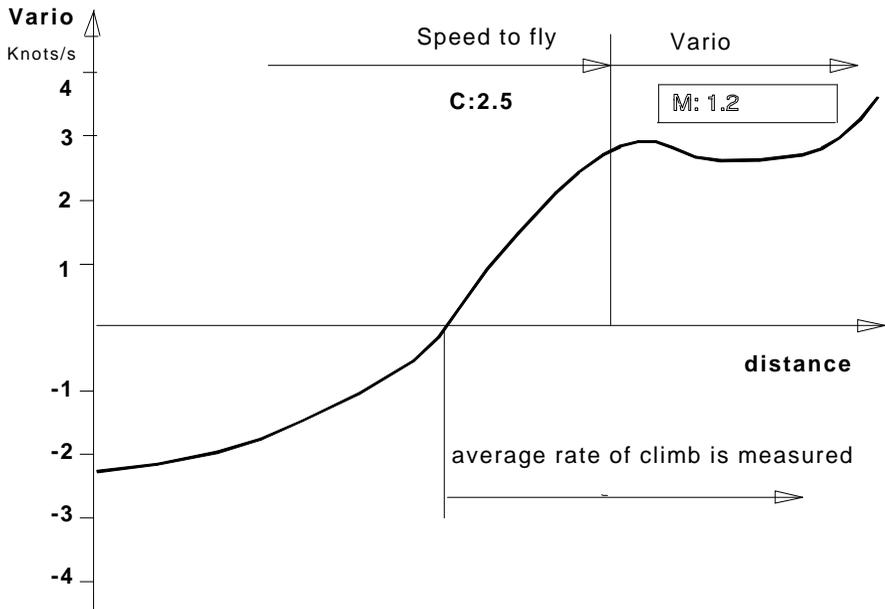
Fig. of 3.2-1: Average Rate of Climb (start of data capture)

If you decide (based on the positive rising air reading and the
encouraging speed-to-fly indication) when approaching
thermalling speed to start circling, simply switch the flight-
mode switch (8) to '**S**' "Climb" position. The computer will
immediately give you the average rate of climb over the last
few seconds because the integrator immediately takes into
account the current rate of climb excluding any previous sink.
With this you receive immediate information on the rate of
climb likely to be archived in this thermal. (Fig. 3.2.1)

This is perhaps the best time to mention the optional second
speed-to- fly vario instrument. In this case, switching the vario
to speed-to-fly only affects the audio tone.

3.3. The *Normal* or Cross country mode

3.3.1 Display Mode in the Normal or Cross country mode

As soon as the Statistic-/ Final glide-switch (8) is switched in the **mid position**, the other 3 display quadrants are programmable to display preferred information. You select the menu information out of a two-dimensional menu-matrix using the menu selector knob(4) and the **+/-** toggle switch (9).
 The charts for selecting the menu-programming are on separate **laminated cards** (one each for single and double row display models). The matrix in the table assists you in selecting the appropriate menu and works with the computer during the flight. If you have a desire to portray a certain information on the display you select the item out of the laminated card. The menu selector knob(4) corresponds to the table-column, and the **+/-** toggle switch(9) selects the wanted menu-mode line. In order to quickly orient yourself the menu-matrix displays information status on the top-right quadrant (exceptions: Menu-position, **0/0,** [1] in menu-row 2 with selected turn-points in the top-right quadrant). You can find more exact information regarding the status line in Chapter 3.5.
<u>Example:</u> The display reads:

```
C: +0.7          →← 3/2
S2:  0           V2:  0
```

To check the Battery voltage, with the momentary menu-position currently at **3/2**, check the menu-matrix to find **0/5** denoting battery voltage. To check the voltage you must turn the menu knob to position **-5-** and toggle the **+/-** switch so that the display reads **0/5**. The display then displays:

```
C: +0.7          →← 0/5
Bat:13.2V        76.3°F
```

(The temperature-information appears only on systems with optional temperature measurement!). You can find more exact information about display programming possibilities in subsequent chapters. Incidentally, menu-line 0 is always displayed after power-up, so that you do not have to search for this important information.

[1] The Menu-position „3/2" meant, that on the computer-display the menu-row 3 is selected for to the Menu-selector rotary switch Position 2 (Matrix-column 2)

Example:

N:-0.7	→← 3/2
S2: 0	V2: 0

Whit the leg of the flight S2 and the average speed on the section V2, this selection equals to the matrix position in the Menu selection Table.

3.3.2   Correction of Stored Data

Initial values must be entered correctly (e.g. Wing Loading and Airport-altitude). You will always be dealing with the same routine: First select the Display Menu-positions with help of the **MENU**-selector knob(4) and the **+/-** toggle switch, followed by the **ENT** toggle switch. Correct the values with the proper knob position and the **+/-** toggle switch (e.g. the Wing Loading with 'WingLoad', the airport-altitude with 'APT-Alti' position etc.). By pressing the -**KORR-**toggle switch(10) in the up position the correction-mode is selected. Toggle the **+/-** switch(9) to correct the stored value to the preferred current value. The correction-process is concluded by pressing the toggle-switch(10) to **ENT.** The corrected data is now stored in the memory, and will not lost by powering down the computer (e.g. the stored airport-altitude remains in the memory until you are at another airport and newly reprogram the altitude).

Example: You take-off with the standard-menu-position 0/0. A wing loading of 8 lbs/sqft was programmed prior to takeoff. Under way the thermals get weaker and you therefore empty the water-ballast thereby reduce wing loading to 7 lbs/sqft. The flight computer is set to menu-position 0 and needs to be rotated with the menu-selector-knob to position 0/10 (full-right turn, easily selectable). The display depicts:

```
C:+0.5         ->3  0/10
WL: 8.0
```

By pressing the toggle-switch (10) **KORR-** '**WingLoad:?"** appears with a blinking question mark.

```
C:+0.5         -><- 0/10
WingLoad:? 8.0lb
```

Pressing the **+/-** toggle-switch(9) up/down respectively increases/ decreases the value with 0.1 lb./sqft. increments. The other method is to move to the desired value: press and hold

the toggle-switch(9) up/down until the value is reached. In the example you therefore press and hold down the **+/-** toggle-switch(9), until the value Wing Load: ? 7.0lb appears on the display. Then you release the switch to the center position and by pressing the **ENT** toggle-switch(10) down, your desired value is programmed.

```
C: +0.5          ->< - 0/10
WL: 7.0
```

Corrections are possible only for: glider model, programmable display mode(menu-position '0/0'), QFE-altitude, airport-altitude, distance and final-glide-distance (only without GPS-reception), Time and date, Compass-Compensation(option).

Menu-select (n)	Display-Mode	1.Correction platform	2.Correction platform	3.Correction platform
0/0	Programmable Display quadrant	Line ur: (upper-right)	Line dl: (down-left)	Line dr: (down-right)
0/1	QFE-Altitude **a**	QFG-Altitude	QFE-atmospheric pressure	-
0/2	QFH- Altitude **A**	Airport Altitude	QNH-atmospheric pressure	-
-	Power-On Display	glider model	-	-
0/ 4	Time	Time	Date	-
0/10	Wing Load WL	Wing Load WL	-	-
1/0-1/9	Legs S1-S9	Legs S1-S9	-	-
S9/5	Correction of the flight-number	Flight-number	-	-
EA	Final-glide	active Leg Sn, so that final glide-distance ΔE and $D\Sigma$	-	-

Figure 3.3.2: Possible Correction Combinations

3.3.3   Freely programmable display menu position 0/0

The display layout corresponding to this menu position can be freely programmed according to your needs. Most likely it will be the page you will select most often in flight, and it can therefore also be brought up for display very easily: The menu page 0/0 appears automatically after the unit is turned on - and is quickly selected by rotating the menu knob all the way to the left. The only preprogrammed and fixed display is the average rate of climb(C) (the net vario reading) on the top left quadrant. If you would like to change the information displayed on the other quadrants, you press the 'KORR' switch and the lower display line will, for example, show:

```
C: +0.0      xxxxxxxx
Line ur:     QFE-alti
```

Using the '+/-' switch you can select from the table 3.3.3 (Layout possibilities for the programmable display page in menu position 0/0) the information you would like to have on display on quadrant 1 (**Line ur** - upper-right), and use 'ENT' to confirm it. After that you are in the correction mode for quadrant 2 (**Line dl**- down-left) and - after confirming it - you will be able to program in the same way the display for quadrant 3 (**Line dr** - down-right). In case you would like to change the layout again at a later time you simply press the 'KORR' switch while in menu position '0/0'. After turning off your VW921 the last programmed layout will remain stored in the memory.

Display mode 0/0 selections for upper-right quadrant(Line ur)

Description in the Display	Symbol	Flight computer-configuration (options)

		+14	10 +15	11	34	35	37
Empty		X	X	X	X	X	X
QFE-altitude	A	X	X	X	X	X	X
STD-altitude	AS	X	X	X	X	X	X
Clock time	c	X	X	X	X	X	X
Flight-**time**	t	X	X	X	X	X	X
Battery **Disp**lay	Bat	X	X	X	X	X	X
Target-**T**urn **P**oint	*Name*			X	X	X	X
Bearing	P			X	X	X	X
Display		X	X	X	X	X	X
Main Climb	c	X	X	X	X	X	X
Thermal Climb	c	X	X	X	X	X	X

Display mode 0/0 selections for bottom-left quadrant (Line dl):

Empty		X	X	X	X	X	X
Display				X	X	X	X
Flight-**time**	t	X	X	X	X	X	X
Battery **Disp**lay	Bat	X	X	X	X	X	X
TAS	V	X	X	X	X	X	X
QNH-altitude	A	X	X	X	X	X	X
QFE-altitude	a	X	X	X	X	X	X
Bearing	P			X	X	X	X
Temperature	T		X		X	X	X

Display mode 0/0 selections for bottom-right quadrant (Line dr)

Empty		X	X	X	X	X	X
Distance	d	X	X	X	X	X	X
Battery **Disp**lay	Bat	X	X	X	X	X	X
Clock-time	c	X	X	X	X	X	X
Track	TRK			X	X	X	X
ΔV-Display	ΔV			X	X	X	X
MC-Speed							X
Gesamt-V *	ΣV_						X
Wind Empf	Wind+						X
Cross Error	ΣV_						X

Compass	Com					X	X

* Gesamt = Total

Table 3.3.3: Layout possibilities for the free programmable
display page in menu position 0/0. (x = possible)

3.3.4 Display quadrants in the Cross country mode

In the following you will get an extensive overview of the
Cross Country mode information. The information is organized
in alphabetical order of the **abbreviation** (1st. column). The
2nd. column displays the basic **meaning**, the 3rd. column
displays the **unit** types, and the 4th. column displays which
menu-quadrant of the cross country mode contains the
displayed or desired information.
Example: The upper-right (UR) quadrant displays 3/4 which
signifies, menu-column of 4 (menu Knob), menu-position 3 (**+/-**
toggle switch selectable),bottom-right display quadrant. In the
5th. column an example is presented.

Short Name	Name	Unit	Where ?	Example
Remarks				

→	**Display position**	-	*/* UR	→3 1/8
				→← 0/6
The left arrow → always points to the currently activated leg, for example at the start of the third leg →3 will be displayed. If no leg is active, instead of a number a second arrow pointing into the opposite direction is displayed → ←**.**				
	Angle	°	0/1 DR	→ 21°
			0/0 UR	
			0/0 DL	→ $$$°

The *angle* is analyzed by GPS-reception. The angle-difference between bearing and programmed-course is given with → or ¨ which signifies a command to correct the course to the right or left. The example above signifies "Correct 21° to the right". The $$$ appear, if no GPS-reception is available.

ΔV	Speed-difference	Knots / h	0/ 9 DR	ΔV

(only available with GPS-reception) The difference between the air-speed and the ground-speed V; in linear-flight this value is a measurement for the instant wind-component. This value is evaluated with a relatively short integration-time (5 seconds). The computer can only give valid information if during the integration-time a straight-flight path is flown to the turn-point. This 'Wind-component' is especially valuable if it is compared with the wholly independent long-time-integration wind component received in the position 0/9 DL.

-	Position at GPS-reception	-	0/ 3 2/10	N494840 E120705

This display quadrant displays the coordinates of the momentary position. The information is displayed in degrees/ minutes/ seconds, but without punctuation between the values.

Bat	Battery -voltage	V	0/ 5 DL 0/ 0	Bat: 12.4V

This display quadrant displays the charge condition of the battery. It should be checked, with simultaneous activation of the radio transmit button.

BRG	Bearing	°	0/ 8 DL	BRG315 °

Bearing is always understood as the bearing on the activated turn-point. (always identical with, Sn, n being an active route-number.)

Dn	Distance n - without GPS-reception programmable	nm	1/ n DL	D6 23.8"

Distance is <u>always</u> understood as the yet to fly route. It is displayed with these three symbols:

'″': inactive leg, distance between Turn-point of n-1 and Turn-point n

'_:' active leg as a track over the ground.

':': active leg, distance of momentary position to the active turn-point n

dn	active Distance n	nm	1/ 0 DL	d3: 84.9

The distance of the active leg in menu-position of 1/ 0 with lower case characters.

DΣ	Total-distance	nm	1/ 10 DL	D:Σ 32.8

The *Total-distance* is the sum of all partial-distances. In this category the total route-length is found. It includes your current leg, what you previously flew, and what is programmed but not yet flown. The same nautical miles value received into the final glide as ΔE

WL	Wing Loading - programmable	lb./sqft	0/ 10 DL	WL:7.1

The programmed Wing Loading can also be used as a correction-algorithm (Chapter 3.3.2) and the programmed value modified.

h	QFE-altitude - programmable	ft	0/1 DL 0/0 OR 0/0 DL	h: 723

The QFE-altitude is the relative altitude referenced to the base-airport-altitude.
- resets automatically to 0 ft at power-up.
- this automatic 0 ft of the QFE-altitude must be programmed with the airport altitude and stays on the programmed value until power-off
- after take-off and reaching a total-energy pressure from the air speed of 54 knots/h a reference-value of 131ft is added. (131 ft equivalent altitude).
- this altitude is the reference-altitude for the final glide!
- it can be adjusted during the flight in menu-position 0/1 if the barometric pressure changes.

A	QNH-altitude - programmable before the flight	ft	0/ 2 DL	A: 823

The QNH-altitude is the total-energy compensated altitude over MSL (without temperature-correction).
- calculated as sum of QFE-altitude and airport-altitude (Elevation)
- the airport-altitude is programmable only before flight
- a programming of the airport-altitude during the flight is interpreted as the airport-altitude of the destination-airport and does not change the QNH-altitude, but the QFE-altitude over this destination-airport.

AS	Standard-pressure altitude	ft	0/ 0 UR	AS 789

Altitude over the 1013.15 mbar-level, real altitude-value of the total-energy-altimeter, calibrated at the factory.

Af	Standard-pressure altitude	ft	0/ 0?	Af

Also total-energy-compensated-altitude over the 1013.2-mbar-level, agrees with the real flight-altitude, i.e. a displayed value 6000 agrees with a flight-level FL of 60.

You will find more information regarding altimeter functions in chapter 3.6. "The Altimeter".

MC	**McCready-value** **- temporary**	**ft/m** ***100**	***/* OR**	**MC: 2.5**

Temporary display of the McCready-knob position, which is shown for approximately 2 seconds to each MC-alteration with the MC Knob (5) in the top-right display-quadrant.

Pn	**Bearing n** **- only with GPS-** **reception**	**°**	**1/ n UR**	**P6" 216**

The bearing always gives the right course from turn-point to turn-point, in dependency of the 3 signs:
'"': inactive leg, the bearing between Turn-point of n-1 and Turn-point n
'_:' active leg as a track over the ground.
':': active leg, bearing of momentary position to the active turn-point n

pn	**active bearing n**	**°**	**1/ 0 UR**	**p3: 83**

The active bearing-value displayed again in menu-position 1/ 0 with lower case characters

T	**Temperature** **- optional**	**°C**	**0/5 UR**	**13.0 °C**

Displays the temperature at the Temperature-sensor location.

Sn	**Leg n**	**nm**	**3/n DL** or **2/n DL**	**S6" 0.0**

The already covered distance of leg *n*. If the valid start and end point were over-flown Sn will be set to the programmed value. When the active route is displayed with GPS-reception only the course-line route is recognized as completed. It is displayed as one of these 3 signs:
'"' inactive leg   '_' active leg, no flight-signal
':' active leg in flight

sn	**active leg n**	**nm**	**3/0 DL** or **2/0 DL**	**s3:** **23.8**

The already covered distance on the active leg.

SΣ	**Sum of all-legs**	**nm**	**3/10 DL** or **2/10 DL**	`S:Σ 283`
The sum of all the already covered legs.					

Sto	**Flight-speed-sensor-distance**	**nm**	**0/**	`Sto` `283`
Here the total nautical mile-performance is summed, from the flight-speed-sensor and the circle/glide switch which received signals and analyzed them since takeoff .					

t	**Flight time**	**h**	**0/ 4 UR** **0/ 0 DL** **0/ 0 UR**	`t 3: 41`

TRK	**Track**	°	**0/ 8UR**	`TRK`
				`219°`
				`TRK`
				`$$$°`

The *Track* is the current movement-direction over the ground. Wind-shifting and the alike in opposition to compass direction are not considered.					

U	**Time -programmable**	**hh:mm**	**0/4 DL** **0/0 OR** **0/0 DL** **0/0 UR**	`U13:42`
The programmable real-time-clock includes the Time and Date. By pressing KORR the programmable value will be displayed (Side 1: Hour, minute) (Side 2: weekday, day, month, year) and by selecting ENT the corresponding side is stored.					

V	**True Air Speed (TAS)**	**knots/ h**	**0/6 DL** **0/0 DL**	`V:93`

Momentary **True Air Speed (TAS)** is the altitude corrected speed in the air . Note: If you fly higher and faster, than the TAS will deviate more from the air-speed(IAS) indicated air-speed.

Vg	**Leg-speed**	knots/ h	3/ n DL or 2/ n UR	V6"0.0 V2:83.8

The achieved average-speed over the ground, attained from the respective partial legs (altitude-variation will correspond to the achieved average Climbs).

:'"' : inactive leg   '_' : active leg, no flight-signal

'**:**' : active leg in flight

vn	**active leg-speed**	knots/ h	3/ 0 UR or 2/ 0 UR	v2"78.9

Active leg-speed is displayed only after 15 minutes in the new leg. After beginning a new leg, for the first 15 minutes the average-speed of the last leg is shown.

1. The active route has yet no usable results.

2. Average-speed over ground archived on the last leg.

VΣ	**Average Leg-speed**	knots / h	3/ 10UR or 2/ 10UR	V:Σ 73.7

Average-ground-speed on the previous-legs flown (and recorded)

WD	**Wind-component - temporary**	knots / h	+/ OR–	WD: +15

Preset the wind-component with the Wind knob (6). Following a three second delay the selected value appears on the display, after that the display is updated more frequently.

Wind	**Wind-component**	knots / h	0/9 DL	Wind +13

> **with GPS:** From the real flight route above the ground and the flight route in the air, the wind-component is calculated over the last 10-20. (independent of ΔV)
> **without GPS:** The wind component is calculated from the exact correction of the distances on the route-section.
> In both cases the value is only received if the flight-route is in the direction of the target-point.

3.4 The statistics-mode[2]

Thanks to the development of inexpensive memory chips it is now possible to record all the data which the computer handles during a long cross country flight, process it, and make it accessible to the pilot either during or more usually after the flight.

In this way the computer becomes a flight data recorder which is far superior to the conventional time/height barograph trace in terms of both resolution and the sheer wealth of numeric information contained.

The statistics-mode is a display-mode, in which the display alone changes, all other processes run in the background unaffected and continuously. This special display mode is activated by switching the *Statistic/Final Glide* switch (8) up to *S* position. The majority of the recorded data is available for display during the flight. The displayed menu-matrix (already familiar from the normal or Cross country mode) has been expanded with a 3rd. dimension. A descriptive illustration is shown in the three-dimensional statistics-matrix in Appendix A1.

Contrary to menu-matrix selection, here, the *Menu-knob* (4) selects the display row and the column selection is performed with the *MC Knob* (5). The *+/-* toggle switch (9) selects the third dimension of the matrix (in which thermals and glide section data is stored). To separate the statistic display values from the normal mode in this manual, the statistics display menu-position is displayed with the character "S" as a prefix. I.e: the menu-position, **S3/4** signifies that: Statistics-matrix

---

[2] Only with Statistics Option

display mode of 3 (Menu-knob on position 3) and column 4
(MC Knob on position 4 respectively on a value of 2). In order
to find the statistics-data during the flight quickly, designation
for the VW921 display position statistics-matrix is provided on
a laminated card. Portrayed as a two-dimensional level of the
statistics-matrix, you will find a detailed description of each of
the display rows of this statistics-matrix in the following
chapter. (3.4.1.)

3.4.1 Statistics-Matrix Display-Rows

Row 0 = *Thermal* Registers: In this display mode you receive all the stored information relating to **thermals**. Example: for Thermal-No. 11:

Thermal S0/0: Total climb of the thermals

```
C:0.0        Thermal
C.Nr 11:   6.4 f/m
```
☝ **X100**

Thermal S0/1: gained altitude

```
C:0.0        Thermal
ΔA.Nr11:     2050ft
```

Thermal S0/2: Thermal entry altitude

```
C:0.0        Thermal
A.In 11:     2759ft
```

Thermal S0/3: Thermal exit altitude

```
C:0.0        Thermal
A.Out 11:    4810ft
```

Thermal S0/4: Circling-time

```
C:0.0        Thermal
Δt 11:       03:15min
```

Thermal S0/5: Position (nautical miles) of the total flown distance

```
C:0.0        Thermal
S.Nr 11:     183nm
```

The Thermal-register stores sampled data in circling mode which lasted longer than 30 seconds. Data sampling is triggered automatically by speeds lower than circling/glide switch-over

speed (Wing-load dependent, see table ???). C: displays the same value as the Variometer round-instrument. Also if circling in a sink, negative values are registered as thermals.
It is important to use a flight-style which clearly separates straight distance flight and circling. This results in concise and clear statistic data. The flight-computer has 99 thermal-registers to store data from thermals, enough for any long flight. With this detailed data-recording you have a new, more exact and also more comfortable 'note-pad' for flight-analysis.

Row 1 = "*Climb*" registers: Climb-register selection is performed at position 1 of the *Menu-selector* knob (4) in the statistics mode. This displays all global information, that involves the climbs, e.g. Total-altitude-gains, total-climb-time etc.
In the columns you will find:

Climbs - S1/ 0: Total-altitude-gain

C:0.0	Climbs
ΔA.total	10540ft

Climbs - S1/ 1: Averaged rate climb from all registers

C:0.0	Climbs
C. total:	4.2 ft/m

☝ x100

Climbs - S1/ 2: Altitude-gains in the climb-registers with maximum Altitude-gain and associated Lift-number

C:0.0	Climbs
ΔA.max 8:	2240ft

Climbs - S1/ 3: Average climb in the registers with maximum altitude-gain

C:0.0	Climbs
C.ΔAmax:	3.6ft/m

☝ x100

Climbs - S1/ 4: Altitude-gains in the climb-register with

maximum climb and associated Lift-
number

```
C:0.0          Climbs
ΔACmax   3:    1417ft
```

Climbs - S1/ 5: Average climb in the climb-registers with
maximum climb

```
C:0.0          Climbs          ☝x100
C.Cmax:        7.6ft/m
```

Climbs - S1/ 6: Thermalling-time during cruise flight (in
hours

and minutes) and relatively to the total-
cruise

flight time

```
C:0.0          Climbs
t.Cl      1: 04/ 23%
```

Climbs - S1/ 7: Number of the recorded thermals

```
C:0.0          Climbs
Thermals:      15
```

Climbs - S1/ 9: Average climb while in cruise flight with
the respective number of the thermals

```
C:0.0          Climbs          ☝x100
C.Σ(12):       4.6ft/m
```

Climbs - S1/ 10: Average climb of the last 3 thermals

```
C:0.0          Climbs          ☝ x100
C.Σ (3):       4.8ft/m
```

Row 2 = "*Cruises*"-registers: In menu-position 2 the Cruise-statistics is recorded for each single cruise-distance. With the **+/-** toggle switch (9) the single cruise-distance of the statistics-flight register is selectable.

- S2/ 0: Nautical-miles of the total-route length at the start of the Cruise-distance

```
C:+0.0          Cruises
ΔL.Anf  18:      116nm
```

- S2/ 1: Nautical miles of the total-route-length at the end of the Cruise-distance

```
C:+0.0          Cruises
ΔL.End  18:      134nm
```

- S2/ 2: Completed route in Cruise-section No.18

```
C:+0.0          Cruises
ΔL.Nr   18:     18.8nm
```

- S2/ 3: Start-altitude of Cruise-section No.18

```
C:+0.0          Cruises
A.In    18:     4100ft
```

- S2/ 4: Altitude after ending Cruise-section No.18

```
C:+0.0          Cruises
A.Out   18:      820ft
```

- S2/ 5: Altitude loss on Cruise-section No.18
  (most a negative value)

```
C:+0.0          Cruises
ΔA.Nr   18:    -3280nm
```

- S2/ 6: Cruise-Time for section No.18 in minutes and
seconds

```
C:+0.0          Cruises
Δt  18:      15:00min
```

- S2/ 7: Total number of Cruise-sections

```
C:+0.0          Cruises
Cruises    :    21
```

Row 3 = "*D.Total*"-registers: In menu-position 3 of the
display mode the total-distance values are shown. The
statistics-register positions are:

- S3/ 0: The total of the leg-distances takeoff to landing.

```
C:+0.0          D.total
Leg Σ          108nm
```

- S3/ 1: The total-time t.LΣ used for flying the total-
LegΣ (hours/minutes). This is 100% of the total
flight.

```
C:+0.0          D.total
t.L Σ      1:25/ 100%
```

- S3/ 2: The achieved average-ground-speed GS.LΣ
on the   total-route, GS.LΣ= LegΣ / t.LΣ

```
C:+0.0          D.total       ☞ knots/hr.
GS.LΣ :         76.1kn
```

- S3/ 3: The achieved average-air-speed TAS.LΣ on the
total-route.

```
C:+0.0          D.total       ☞ knots/hr.
TAS.LΣ :        142kn
```

32

- S3/ 4: The total-altitude-gain on the total-route

```
C:+0.0          D.total
ΔA.total:       12631ft
```

- S3/ 5: The average climb on the total-route

```
C:+0.0          D.total        ☞  x100
C.total:        4.2ft/m
```

- S3/ 6: Out of the average climb on the total-route,
       theoretically attainable McCready-speed (MC-
       speed)

```
C:+0.0          D.total        ☞  knots/hr.
MC-speed        46 kn
```

- S3/ 7: The Glide-ratio is the relationship between route-
       length and gained altitude

```
C:+0.0          D.total
Glide-Ratio:        41
```

Row 4 = "*D.Single* "-registers: The statistical data identically
       organized like Row 3, in these registers each single leg
       information is stored individually. The **+/-** toggle switch
       (9) picks the individual legs. Example:

- S4/0: Leg-1 distance from takeoff to turn-point 1.

```
C:+0.0          D.singl
Leg1     :      120nm
```

Row 5 = "*Maximum* "-registers: In statistics-menu-position 5
       miscellaneous maximum information is displayed. Only 4
       registers are used.

- S5/ 0: Altitude gain in the thermal with the maximum altitude gain ΔAmax with thermal-number information. Also see "S1/2".

```
C:+0.0        Maximum
ΔAmax  2:        3608ft
```

- S5/ 1: The climb in the thermal with maximum Altitude-gain M. ΔAmax, also see "S1/ 3".

```
C:+0.0        Maximum
C.ΔAmax:        3.6ft/m
```
☞ **x100**

- S5/ 2: Altitude-gain in the thermal with maximum climb and the associated thermal-number. Also see "S1/ 4".

```
C:+0.0        Maximum
ΔACma 3:        1417ft
```

- S5/ 3: Average climb in the thermal with maximum climb,
  Also see "S1/ 5".

```
C:+0.0        Maximum
C.Cmax:        7.6ft/m
```
☞ **x100**

Row 6 = "*Times* "-registers: Here the summarized times are displayed.

- S6/ 0: The flight time t.tot with percent-information. The percent-information references the total-distance of the flight time.

```
C:+0.0         Times
t.tot     2:00/ 141%
```

- S6/ 1: The total-cruise flight time t.L∑. Also see -S3/1.

```
C:+0.0         Times
t.L∑      1:25/ 100%
```

- S6/ 2: Thermalling-time during the active cruise flight. Also see S1/ 6

```
C:+0.0          Times
t.Cl      0: 25/ 29%
```

- S6/ 3: Glide time during cruise flight, in respect to the total flight-time t.tot corresponding to thermalling-time t.ClΣ

```
C:+0.0          Times
t.Cr      1:00/ 71%
```

- S6/ 4: Flight time of the legs t.L1. Part-route lengths n are selectable with the **+/-** toggle switch.

```
C:+0.0          Times
t.L1      0: 50/ 59%
```

The statistics-menu-position 7 and 8 are not used on the VW921 flight computer. In display mode 9 and 10 no statistics-data is portrayed, but in display mode 9 the flight-logbook administration is displayed (see the detailed description to the flight-logbook in chapter 6.1.3, *Flight Logbook Storage*). In display mode 10 exact information from the wind-sector is displayed (only in versions with compass-linkage, otherwise this display mode is empty).

3.5   The final-glide mode

The last of the three display modes is selected by pressing the **mode-select**-switch(8) to the down (**EA**- final glide) position. In this mode the display has only one mode and no option for selection. The display-quadrants show the following information: **top-left** the selectable Variometer display with the average or net-climb. The display value on the **top-right** quadrant displays information in the following manner:

1. Without active GPS-linkage- used as an altimeter display (selectable on the ground as to which altimeter mode is displayed),
2. With active GPS-linkage- used to display the speed-difference
   $\Delta V = Vg\text{-}TAS$. This advises that the selected wind on the wind knob (6) is essentially larger or smaller than the calculated wind-component ΔV and your wind-attitude strongly deviates from the short-time wind-recommendation.
3. with active GPS-linkage and with matching wind attitude, the angle between the bearing and course over the ground with direction-pointer is shown.

The three display value is for an exact direct final glide without detours, this is especially advantageous. If you hold this angle on zero, you are guided by the flight computer directly to the turn-point-coordinates. (Note: in stronger wind during circling, based on constantly shifting wind-component, the display between the above display-modes alternates between 2 and 3.)
The display quadrant on the **bottom-left** shows a non adjustable value for the glide-path deviation ΔA. In the **bottom-right** quadrant of the display the remaining distance $\Delta E\_$ is displayed. It is identical with the yet to fly total-distance $D\Sigma$.

More information about the final glide mode in chapter 6.

3.6   The Altimeter

You may receive the following altitude-information(in feet) from the flight computer:

- the standard pressure altitude **AS**
- the QFE-altitude **a**, relative altitude over the start-up airport
- the QNH-altitude **A**, airport altitude above **M**ean **S**ee **L**evel
- the Glide-path-deviation ΔH

There is only one altimeter in the VW921, the total energy compensated altimeter, which provides reference for the calculation of the other altitude-values. This altimeter measures the energy compensated barometric pressure, compares it with the standard barometric pressure of 1013.2 mbar and converts it into the standard-pressure altitude *AS*. This information is parallel to the altimeter-information at an adjustment on standard-pressure of 1013,2 mbar. Through adjusting the altimeter pointers to 0 ft you get the QFE-atmospheric pressure of your position (momentary airport barometric pressure). The VW921 automatically engages at 0 ft QFE-altitude when the unit is turned on. The QNH altitude *A* in menu position '0/2' is at the same time automatically set to airport elevation. If the atmospheric pressure changes during the flight, you must compensate for the pressure change and adjust the altimeter, i.e. the flight computer expects the same correction. That happens with the simple correction-algorithm on the menu-position of **0/1**, where the QFE-altitude can be found. Press the **KORR**- button only once, so you can change the QFE-altitude as altitude over your destination-airport immediately. By receiving barometric pressure data from nearby reference-airport, you can adjust the computer to the exact atmospheric pressure by pressing the **KORR**-switch the second time.

For the final glide the QFE-altitude alone, is relevant. Only the altitude over the destination-airport is the reference-altitude for the glide-path-deviation.

For this reason it is very important to familiarize your self, with all possibilities of the altimeter adjustment. Of notable importance is the QFE-altitude, the adjustment is performed automatically when powered up and no correction is required. The other important altitude is the QNH-altitude *A*: This agrees with the altimeter-information, if you adjust this to the airport-altitude before takeoff. The QFE altitude is the reference altitude for final glide, it can be adjusted during flight in menu position '0/1' if the barometric pressure changes. In order to enter the changes it is temporarily necessary to leave the final glide mode, but this should not cause problems since all current data remains in the memory.

- The potential energy is equivalent to 121 feet altitude, which is necessary for the total energy altimeter to guarantee a minimum arrival speed of 54 knots/h. It is accounted for automatically when the unit is turned on. '0 ft' translates, therefore, into -121 feet on the total energy altimeter.(calculated to standard-atmosphere and without temperature-correction). The altimeter-information helps especially in the mountains, to scan for obstacles, passes etc. Therefore you should pay attention to it before takeoff. Make sure the QNH-altitude (menu-position of 0/2 DL) is set on the altitude of the takeoff-airport. An exact altitude adjustment does pay off especially, if your destination-airport has a different altitude then your takeoff-airport.

Example: You fly cross-country from California City (airport-elevation 2437 ft) to Lone Pine (airport elevation 3680 ft). The displayed takeoff-airport-altitude is yet to be set on a value of 2430 ft before the takeoff (the altitude-resolution is 30 ft). So, on the display of the VW921 a QFE-altitude *a* = 0 ft and a QNH-altitude *A*= 2430 ft should be displayed before takeoff. These values are independent of the current atmospheric pressure, because this is stored only internally in the flight computer as a reference pressure-value for the entire flight. After takeoff the QNH-altitude and QFE-altitude maintain a constant difference value of the airport-altitude. E.g. At 1800 ft over the airport the computer displays: *a* = 1800 ft and *A* = 4230 ft. Any time during the flight (preferably, before the final glide) you want to set the QFE-altitude on the altitude of your destination-airport. You can perform that through a direct

alteration of the QFE-altitude (this possibility already exists before the flight, but then your QNH-altitude at the moment of takeoff is incorrect). It is best to make the correction during the flight by selecting menu-position 0/2 (QNH-altitude), invoking the correction-mode, and putting the airport-altitude on the target-airfield. In the case of our example 3680 ft (Lone Pine).

The QNH-altitude stays exactly on the previous altitude. It is airfield-independent, thus an alteration of the goal-airfield-altitude doesn't change the QNH-altitude), but the QFE-altitude has been modified to this corrected altitude correspondingly.

Atmospheric pressure-changes during the flight are corrected with the corresponding alteration of the QFE-altitude.

4   Measuring Distances

The basic flight computer model already processes data provided through the high-precision piezo electric pressure-sensors necessary for the exact calculation of a final glide. It makes sense therefore to use this precision for the rest of the flight so that distances flown and height-corrected average cruise speeds (TAS) can be displayed as digital read-out, taking account of the wind. Using the additional options like GPS-Navigation and/or compass-linkage, the user-friendliness of the flight computer through the greatly simplified positions- and distance-determination of more displayed altitudes and the accuracy and reliability of the derived values (e.g. Wind, final glide altitude) again further improves and reduces pilot workload.

The utilization of satellites- and other navigational-aids necessitates however, a sophisticated software, which differentiates between signal sources derived from the GPS unit, compass-linkage or data out of the pitot signal. It is normal to have longer pauses at the reception of navigational-data (bad reception of the GPS-satellite feed, powering off the GPS-receiver because of high power-consumption, etc.) the computer links the data so that the pilot always gets the exact route-calculation as measured. . This information helps the pilot with navigation, checking wind strength and in making tactical decisions.

4.1   Distance-sizes

The Flight computer can store up to 9 sections or partial sections of a flight and total-route $S\Sigma$, a "speed-sensor" route S_{to} (total) over the total flight.

Each route-section has corresponding route data that belong to it that describe the flight on this leg. Review the following section for concept details and an overview:

Term	Symbol	with GPS only	Explanation
Leg	S or s		- an already flown distance
Distance	D or d		- yet to be flown distance
Route-time	t		- the flight time on the active route
Route-speed	V or v		- the speed achieved on the route $V_n = S_n / t_n$
Bearing	P or p	X	- the bearing of the location, respectively, the start to the end point of the route
Exit-S-point		X	- the start-point of a route with names (maximum 8 char) and coordinates
Goal-point		X	- the end point of a route with names (maximum 8 char) and coordinates

A more detailed explanation of the single concepts and symbols are available in chapter *3.3.4, The display rows for Normal / Cross country mode.*

A yet not activated leg *Sn* is always set to null. A completed leg *Sm* will be set on the original distance. Vice-versa the yet not activated distance *Dn* corresponds with the distance of the route-length and the distance *Dm,* which is a finished route, is set to null. Meanwhile, with GPS-linkage these distances are set through the GPS-receiver, and should be programmed into the GPS receiver before the flight. More exact hints are in chapter *4.3.2, The route-mode without GPS-linkage*.

The **section Sto** (total) starts and stops automatically by pitot pressure. The measuring starts when airspeed exceeds more then 32 knots/h for more than 10 seconds, and ceases when speed is reduced to less than 22 knots/h.

The **total-route SΣ** is the sum of all partial flight routes of S1 to S9.

The **routes of *S1* to *S9*** can be started and stopped in conjunction with each other, i.e. starting a new section stops the current one. This has the advantage that when flying a triangle for example you only need to start *S1* when crossing the start line - *SS* is automatic. At the first turn point you start *S2* and *S1* stops automatically but *SS* continues to measure. Only when the last section (*S1* - *S9*) is stopped does the total *SS* stop. You can program the sections before take-off so that the distance count is cumulative or a countdown. You either know how much ground you have covered or how far you still have to fly. Distance programming is only possible in *S1* to *S9*; the cumulative total of the programmed sections is held in *SS*. I.e. the route of *S5* is activated only after route of *S4* is completed.

If you prepare your map by marking distances along the route you can easily find your position, estimate flying times, and perhaps avoid the unnecessary risk of pressing on too fast. Section *Sn* can be started or stopped at any time without affecting the other sections. This means that you can record part of a section or leg of a task In terms of distance and speed.

4.2   General Operation

4.2.1   Start of a route

The start of the legs always takes in place with the same procedure and is independent of your display value, respectively, of the activated display mode:
Press the toggle-switch (10) to ENT position for approximately 1.5 seconds, on the right upper quadrant of the display you will see the activated flight section ”*Start S3*" for 3 seconds.

```
xxxxxxxx Start S3
xxxxxxxx xxxxxxxx
```

As of this moment the leg-time is displayed *tn*, the speed-sensor- route is started at null and the flown route *Sn* measurement in direction of your next turn-point is activated. In the upper example the route-time of *t3* = 0 sec and the route of S3 = 0 Nm.
If until now there was no active route, by pressing the toggle-switch (10) to the ENT- position for a longer duration the first leg S1- and also the total-route *SS* is activated. Otherwise if you press the toggle switch to the ENT position a new leg will be activated and the previously active route of S_{n-1} will be halted. Only one route can be active at one time.
Incidentally, it is harmless to depress the toggle-switch (10) to the ENT- position for a longer duration and it will not be activate the next leg until the toggle switch is depressed again.

4.2.2   Reactivating a route

In case you inadvertently activated a part-route or for some other reason want to reactivate your last turn point, tap the switch (10) to ENT- and the input-switch (9) to '−' for about 1.5 seconds.
Notice that in this event the flight time and speed-sensor-route in route of Sn+1 again on the now active route Sn is added.
So is the old distance Dn+1 set back again to the original value of the route, the time of tn+1 and the speed-sensor-route are deleted.
This reactivation is possible only once and also only if the previously activated route has not yet been finished. That means the distance of this route must be greater than 2.7 nm from the next turn point.

What if you have to return to the turn point because of a wrong photo?

11.01.97

4.2.3   Erasure of the Distance-storage

With a simultaneous keystroke (10) to the down position and (9) to the up (+) position you will delete all pre-programmed routes which have not been activated yet.
This procedure is always recommended if you have programmed an entire flight-plan before the flight, and now during the flight you want to change the task. The already flown routes remain with all the data in the storage, only the pre-programmed routes not flown are deleted.

Comment: Computers with the software version 'C ' (displayed at power-up) route-storage and distances are entirely deleted, in this version all routes begin again at null.

4.3   Management of the routes

4.3.1   The route-mode with GPS-linkage

In cases with GPS-linkage there are two different GPS
operation modes possible that also affect the handling of the
routes in the VW921 flight computer. The first mode uses
consecutive input of different turn-points (titled in the
handbook *goal-flight*-mode). When you have reached a turn-
point the consecutive is automatically switched and displayed.
In the computer language and GPS-world we frequently find
the concept of a GOTO function or "turn-point" function.
In the second mode the whole task is programmed into the
GPS memory (subsequently named *task-mode*).
While it appears simpler and more user-friendly to work mainly
with the task-mode, the goal-flight-mode is nevertheless
frequently used, especially with modifying (e.g. decrease) the
task.
The VW921 flight computer automatically recognizes if it has
been connected to a GPS-receiver. It also recognizes if the
GPS-receiver is programmed in the *goal-flight* mode or in the
task-mode. The *task-mode* gets a higher priority. As soon as
the task-mode is activated in the GPS-receiver, the VW921
takes over the entire task, and locks on to that task. In this
way the GPS-receiver has a second complete navigational-
computer to use. The VW921 holds the original task, this
allows the GPS-receiver to do other tasks in the non-function
mode. For example the next turn-points can be executed or
just to experiment (in a Double-seated glider). A special
advantage is the help-function (emergency-function, nearest
way-points), with that you can receive instant data for final-
glide or the next closest airport.

1. Task-mode
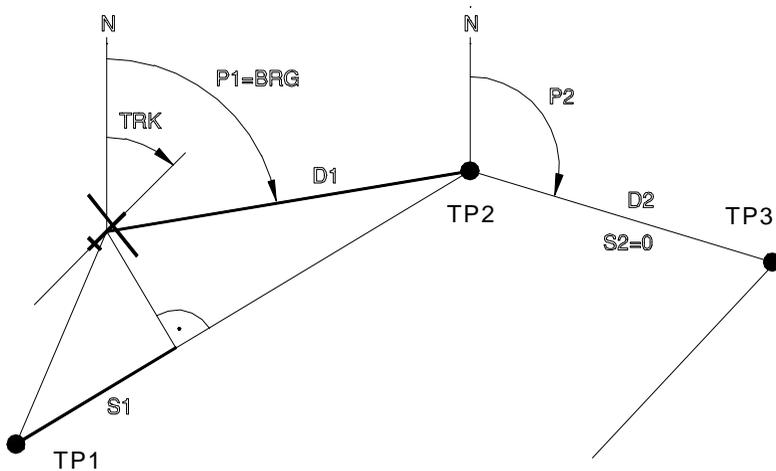
Fig. 4.3.1-1: Schematic depiction of the indicated sizes at active route of leg 1 (S1), distance D1, TRK = track (course over ground), P1 = BRG = bearing (bearing to the turn point of TP2), distance D2= distance from TP2 to the turn point TP3 (yet not active), bearing of P2 is the bearing between both these points.

In the *task-mode* the first programmed point is the *start-* (or origin-) point, all other turn-points are to be programmed sequentially. For multiple laps, way-points must be entered multiple times into the GPS-receiver. (Computers with the software version C: there are only 9 turn-points in the VW921 that can be managed. Unfortunately a triple-go around with takeoff out of the middle is not easily programmed. Software version D: Up to 15 part-routes programmable, whereby this task variation is possible). As soon as the start-line is flown over, press the switch (10) to ENT position for more than 1½ seconds, this starts leg S1. The course over the ground goes from the start (turn-point 1) to turn-point 2 on the task list. For the route arithmetic only the route-component is regarded which lies parallel to the course-line. The route-speed derives itself out of the route-component. The distance to the turn-

point is the direct distance over the ground and the bearing is the takeoff line between your airplane and the turn point. Note this peculiarity: at bigger deviations of the course the sum of the distance can be bigger than the original distance between both points.

Schematic depiction of the indicated sizes at active route 1 with route S1, distance D1, TRK= track (course over ground), P1= BRG = bearing (bearing to the turn-point TP2), distance D2 = distance the turn-points TP2 and TP3 (yet not active), bearing of P2 is the bearing between both these points.

In flight with the *task-mode* as opposed to the *goal-flight-* mode with a fixed set assignment offers the following advantages:
- The operation is simpler, when reaching the turn-point, start the next route by pressing the switch (10) to ENT position. This mode abstains from making an automatic switch-over to the next part-route. First after reaching and photographing the valid turn-point only then is the leg finished in the VW921. In this way you can compare the bearing (BRG) to the to approaching turn-point towards a bisector. This comparison is displayed in the flight computer additionally with the information a photo-sector is supported.
A photo-sector is inserted at the turn-point fly-around. Activated for the sector at ± 45° to the bisector and displayed within a distance of .8 nm of the turn-point through a blinking display "Photo" in the top-right display quadrant:

```
xxxxxxxx      Photo
xxxxxxxx xxxxxxxx
```

Keep in mind, that this notification over the photo-sector is only as good as the coordinate information of the turn-point: At a deviation of turn-point-coordinates and a photo-object of around 1 nm this notification is naturally wholly unusable. When reaching the last turn-point (finish-line) the photo-sector is magnified to 180°.
When invoking the final-glide-mode with the mode-select-switch(8) and sometime during the route, the remaining flight distance and the associated required altitude gain (if less than

5.4 nm is) is given. E.g. before takeoff make sure all turn-points are correctly entered, this way the deviation between the route-length in the VW921 and the task position is a maximum 0.5-1 nm (based on different calculation-formula's there will always be small differences).

How does one program a task with multiple laps? Of course it is always possible to either use the goal-flight-mode or the task-mode, and consecutively program all turn-points redundantly. As of version 2.0, there is a new possibility, only program one round and through using an invocation-algorithm attach more rounds: If the last route has already started and in the GPS-receiver the task is still activated, you simply start a new route. If only two or three turn-points belong to the round, the VW921 assumes that a new turn-point has started and attaches just one more round. At 4 or more turn-points it assumes ,however, a start off on the middle of a leg and, attaches the start-point at the next goal out. It leads you directly to the first target-point. You can find an example of the multiple laps in chapter 4.4.4.

2. Goal-flight-mode

For some tasks e.g. POST, FREE DISTANCE or ZIGZAG shaped courses, the route will be determined during the flight. Therefore you can fly without the *task mode*. Because this route-mode is also applicable for parts of the *task-mode* some pilots generally fly in this mode. The advantage is in the consequent flight-mode there is no transition necessary. Before takeoff the first turn-point is entered into the GPS-receiver. Depending on the update-rate of the GPS-receiver (one or two seconds) the VW921 flight computer needs a little time to calculate the data. Now you can start the first route with the VW921- as described above by pressing longer on the toggle-switch (**10**) to the **ENT** position. In the *goal-flight-* mode there is no start-point programmed, the current coordinates are taken as the start-point and the exact course-line is drawn to the first turn-point. At the approach of the first turn-point, before that turn-point is reached, the GPS-receiver can be switched to the next turn-point. The VW921 leads you with distance and bearings on the first turn-point. In the flight

computer the following turn-point is already input, the up coming departure-point is well known and offers you the same photo-sector notification as during the goal-flight-mode. All other turn-points are proceeded analogously.

How can you check if the VW921 works with the right turn-point-data? First of all, in column 0 of the distance-row (menu-position 1) or route-display mode (display mode 3) you can find out which route is active (the number after the lowercase letter). Turn the menu selector knob (4) to this position. With the active route no. 3 (approaching the third turn-point) the following is displayed:

```
N: 0.7 x→ 3 1/3
D3:73.8 P3:  112
```

In the status-display row the active route "D3" and the turn-point "P3" is displayed. Non-active routes would be displayed with a double apostrophe. In the top-right display quadrant the approaching turn-point with name and the coordinates underneath are displayed. In the next menu knob (4) position, you receive the goal-coordinates from the GPS-receiver. While both are identical, this is displayed twice consecutively. You can change the coordinates in GPS-receiver without problems - the VW921 will still lead you on the original coordinates. When coordinates of the following turn-point are inputted in to the GPS-receiver, they change themselves after a delay, to the inputted coordinates. In the distance row the distance between turn-point 3 and turn-point 4 is displayed (in this example after D4 and after P4 of the course-angle between both these points). If the GPS-receiver is pointing right to the next turn-point, it also matches the information for the photo-sector.

At start of the next route (in this case: route 4), route 3 at this point is finished and route 4 is determined as the new route between present position and the current GPS-goal. At the moment of activation of a new route, the goal of the VW921 and the GPS-receiver is updated, so that in the turn-point-display mode this turn-point appears at least twice: Once in the active column of the turn-point-display mode and : Once in the next column with the turn-point of the GPS-receiver. This stays up until input of an other turn-point into the GPS-receiver

is received. A further advantage of these handling algorithms is the possibility of leading a final-glide over a turn-point.
Please note: You have two independent units making calculations of the next turn-point: while you can select and discard any new turn-points with the GPS-receiver, the VW921 flight computer holds steadily towards the old goal, until you have selected a new goal with the GPS-receiver and validated it through entering the new route.
In this way you attach a new route to the other and consequently also put a new route together. When the turn-point is reached it will be logged into the route-list as end point of the last route and as start of the newly activated leg. The radius is chosen large enough, so that it takes into account inaccurate coordinate-information to define the turn-point as valid. The route-calculation is applied even if the turn-point-data incorrect. The goal-flight-mode in the flight computer is converted immediately into the task-mode, as soon as you activate the task-mode (= ROUTE; TASK) in the GPS-receiver.   Before takeoff the complete task is programmed. During the flight three different variations are chosen with following priority and the goal-point-storage is set corresponding to the valid variation:

1. The route agrees with the start-point to the present goal exactly like the route before: Thereupon the route is copied identically with the goal-point-storage. For example, turn-point 4 in the GPS-receiver and turn-point 4 in the VW921 display stay respectively.

2. The start of the task-position (goal-point 0) is identical with the activated turn-point. So that the concatenation-algorithm is utilized and all the GPS-receiver programmed turn-points are flown in the preset sequence.

3. If neither 1 nor 2 apply, the task-position in the GPS-receiver simply attaches to the existing turn-point sequence. In chapter 4.4.3 you can retrace a detailed example of the multiple back-and-forth switching between *task* and *goal* flight mode.

4.3.2   The distance-mode without GPS-linkage

The VW921 flight computers (without GPS-option) version type 1X and (with GPS-option) Versions type 3X, differentiate themselves in their normal display mode by missing the turn-point-display mode (the first version type has a single display row) and less data is displayed in menu-position 0.

  Both remaining menu-positions are generally identical, however, with the restriction that the GPS-version with active GPS-reception inserts the bearing to the next turn-point into the distance row. When operating without active GPS-reception only the distance of the part-routes is displayed. The values of the route-length, distance and route-speeds are calculated and are dependent on GPS-reception. The calculations are run automatically whether missing GPS-reception (i.e. By turning off the GPS-receiver) or a VW921 without GPS-option. When reception of the GPS-signal is newly established, these values are modified with the updated coordinates. So, in principle, it is possible to turn off the GPS-receiver (i.e. to save battery power), the calculation of the values always happens in the most precise form. The following section applies to the VW921 without GPS connection as well as with GPS-connection. The following summarizes both events without GPS-linkage.

    The following are differences if there is an active GPS-linkage. This is especially noticeable in menu-position 1-, the distance row. Without GPS-linkage there is no bearing-angle displayed, so that the right bottom quadrant stays empty. In this event when pressing the **KORR** toggle switch(10) nothing happens. In contrast when a GPS-linkage is active there should be a reaction (correction of the current values).

    The single route-lengths allow themselves to be programmable or correctable at this point. You have the ability to program the route-lengths before the flight. The counting of the miles occurs backwards towards null or the flown routes become negative. In this event the displayed values for the *route S* and the *distance D* are identical except for the minus-sign. In the second event you give up the information as far as the route yet to fly. The programming of the route-mileage is

only possible in single distances of D1 through D15 (= Df), the sum of the programmed distance is stored automatically in DΣ. The programming procedure is the same as making a correction (see Chapter 3.3.2.). You choose the *distance* row with the help of the **+/-** toggle switch(9). With the menu selector knob (4) select the single distance in the display and program / correct this by pressing the **KORR** toggle switch(10) to the KORR position and with the **+/-** toggle switch(9) enter the programmed value by pressing switch(10) to the **ENT** position. This procedure should be repeated for each single distance that you want to put into your route. Prepare the map with the course-route and distances marked, this will help you orient yourself quickly. This will help you to better estimate the flight time so as to avoid unnecessary risk due to flying too fast.

You can check your engaged wind-component on the respective route-length by comparing the route-lengths and the distance-markings. After each distance correction, the flight computer displays a calculated wind value compared to the wind-setting of the **Wind** knob(6) for a short time. The VW921 furthermore notices this suggested value and displays it permanently on menu-position 0/9 up to the next correction. If you use this feature of the distance comparison and adjust the derived wind value with the **Wind** knob(6), you already have an extensive idea of the actual wind situation long before the final glide. This way the flight computer serves as a good navigational-aid. For example you know quite exactly, when you will reach the next turn-point. The activation, reactivation and erasure of routes happens as described in chapter 4.2, in which, naturally, only the distance- and route-storage's are involved.

One more remark regarding the programming of partial-routes with the GPS-version. Maybe your GPS-receiver is defective or you have a VW921 GPS-version without your own GPS-receiver. You could borrow, for a short time, a friends receiver that wants to fly the same route. You only need the GPS-receiver for the programming of the VW921. You only need to connect the GPS receiver once for a short time (max. 10-12 seconds) before the flight to download the distance storage with the exact values and also the entire turn-point-list. Then you can return the GPS-receiver and you used the faster form

of programming. The rest of the route-management works as described before.

5 Final-glide

The computer is particularly useful when used in Final Glide mode. It is designed so that you can check the interaction of all the factors involved (wind component, MacCready value, altitude, degree of bug encrustation on the leading edge etc.) quickly and easily. In this way it is easy to optimize the final glide. The final glide is estimated most to a time, usually commenced when the pilot is already familiar with the day's gliding weather. The pilot knows cloud base altitude, average rates of climb, and will have some idea of what the wind is doing. This enables the pilot to make certain decisions whilst planning the final glide, probably with a higher MacCready value (because that represents additional safety) (5) and with the estimated wind component (6) (only the head-wind or tail-wind vector is of any importance). In addition the pilot must state the distance from his home base airfield as exactly as possible, and for this purpose it pays to use an air map which has been prepared in advance with concentric circles representing distance from the destination (see Appendix 9.2). The computer does not require a special operating state to perform the final glide calculations; these are continually performed in parallel with other tasks. Selecting final glide mode changes only the display format! The display is designed to allow you quickly and at any time to call up all the information vital to a successful final glide. The interpretation of the most important information - glide path deviation, distance remaining, and course deviation (with GPS coupling)- is discussed in Chapter 3.
Chapter 3 explains all display indications, including those for the final glide mode (section 3.5). This chapter concentrates on proper selection of the initial final glide settings, and the interpretation of the various indications. Many examples will be provided in order to demonstrate the available capabilities.

5.1   The Setup Process

In the VW921 all components of the final glide are either directly or indirectly adjustable, but there are also parameters that are automatically set. In the following, all final glide-parameters and the associated setup stages are explained again. The *Final-glide distance __DE__* is the sum of all the unflown part-routes and so is also identical with Total-distance DΣ. The programming or correction occurs only indirectly over part-routes. With active GPS-linkage the single turn-points are programmed in the GPS-receiver and from this the final-glide distance is calculated. Without active GPS-linkage the partial-distance must be programmed. Choosing the correction-mode during final glide the changes to the active partial distance *dn* simultaneously change the total-distance, DΣ (In chapter 3.5. the final-glide-mode is explained in detail).
The *McCready MC* (5) number setting is dependent on the actual weather-situation. For higher MC-number - selected with the MC knob - you need more altitude and from this a resultant higher speed.
The *Wing Loading WL* corrected in menu-position, 0/10 of the route-mode. This value shall always be set to the real wing loading. Before the takeoff check the wing loading for each event, set the value dependent on the pilot weight and on the water-ballast. During the flight correct them after dumping the water, so that this always reflects the actual wing loading.
The *glider-polar* can be checked or modified immediately after power-up. For more details about the polar curve's and how this is selected, check chapter *7.4. Selecting the Glider model and it's Polar Curve.*
A *polar-deterioration* is selected with the polar-switch (7). In middle position (= P0) the correct polar curve is selected for your glider model. The bug-contaminated polar *P1* is selected in the upper switch-position and regards a polar-deterioration of about 5% at 43 knots/h. While the rain-polar, *P2*, in the bottom switch-position is a polar-deterioration of about 15% at 43 knots/h. Because at higher speeds of a stronger influence of contamination or raindrops can be expected, a linear increase of the polar-deterioration over the speed-sector was used. At 86 knots/h this value amounts to therefore 10% (P1) 30% (P2)

respectively, of the polar fall at this speed. If you don't have these calculated polar values for contamination-state for your glider, we recommend the use of a polar curve from a different glider model. By turning off the flight computers and variometer briefly (2 seconds) and powering up again, you can select a glider model with a worse polar (despite the short power off, the flight-data stays stored).

The ***Wind-component*** is selected with the rotary knob (6). Turning it to the left, select a maximum range of - 25 knots/ h (head-wind) and to the right a maximum range of +25 knots/h (back-wind). The raster resolution value is ~ 1 knots/h. For correct wind-component selection for the VW921 has different recommendations that are available to help in choosing the correct wind-component that should be supported. For several reasons, the final decision is left for the pilot:

- In well-known wind-shear, i.e. in valleys or mountains, deviations from the recommended values are already in the setup to be regarded.
- In final glide, over the last turn-point, the last leg in most cases has a wholly different wind-component as the momentary value.
- The wind-component can be used as an additional security-component; In that one can select more or less head-wind.
- Bad news for last: Calculation mistakes, detour mistakes, etc., can lead to an unrealistic wind-component setup. The end result is a total over or under calculation of your final glide altitude reserves.

Out of these introduced final glide-components the VW921 immediately calculates the glide angle of your glider, and over the total distance you also receive the altitude required for a successful final glide. For security reasons the VW921 adds 300 ft. to this altitude. Now you only need the altitude over the destination airport as comparison value correctly adjusted, so that the flight computer can provide the exact Glide-path-deviation. You already know that this QFE-altitude (menu-position, 0/1) adjusts itself automatically at power-up to the altitude of the takeoff-airport. If a correction during flight is necessary, due barometric pressure changes, this adjustment is performed either through alteration of the QFE-altitude or through correction of the goal-airport-altitude on the QNH-

menu-position, 0/ 2. As soon as the flight computer is programmed with the distances, all components for the final glide are calculated, so that this mode is displayed without annoying pre-adjustment simply by pressing the mode-select-switch(8) down to position (EA).

5.2   Applications for the final-glide-mode

Standard application of this mode will be the final glide on the last leg. You want to arrive on your destination airport with a specified speed, and preferably no altitude waste. In the event of an active GPS-linkage it is always exactly predicted out of your location and your goal-distance. Alternatively, (without GPS-linkage), this distance is calculated out of the air-speed (TAS = True-Air-Speed), the *Climb/Glide* switch's activation and the selected wind-component. In the first event, with incorrect wind-component selection only the glide-path-deviation is calculated incorrectly. In the second event, you must compare the remaining distance with your map-position and correct accordingly. In both events you get a wind-component recommendation, with that selection you can enjoy the last miles of gliding, and you will be surprised, how exact the calculated glide-path matches with reality. But do not forget to check the remaining distance (without GPS), the wind-recommendation (with GPS), respectively. Wind plays a strong role with the unfamiliar vertical wind-component.
- It is also equally possible to check the final glide before reaching the last turn-point. In case of an entire task-position (task-mode with active GPS-linkage / programming all partial distance of D1 to Dn without active GPS-linkage) the information always references itself on the entire remaining distance. Contrary to the above, with active GPS-linkage and goal-flight-mode flight, the next turn-point is the final glide-goal, until the turn-point is in the GPS-receiver and the turn-point in the flight computer is the same. The turn-point in this mode is newly programmed in the GPS-receiver. Then the final glide-route leads you around the flight computer activated turn-point on the turn-point of the GPS-receiver. It is

recommended to input the GPS-receiver, a while before reaching the next activated turn-point, so the turn-point is already there it only needs to be activated. Then, when reaching the respective goal, the courses for the turn-points are already well-known- and so is the bisector as well as the photo-sector.

- Contrary to your original plan, because the flight necessitates, you intend to approach a point in the terrain with a distinct-altitude; i.e. with the following possible events:

1. In the mountains you want to cross over a valley with a fixed arrival-altitude above the opposite ridge.

2. You can not find more thermals; You break off your task and want to land on the next airport and therefore change the goal.

3. A long glide lies before you over a thermal-dead area, which you want to traverse with a fixed arrival altitude.

4. While in a cruise flight during the local championship you realize, that the planned task can't be completed in time and you want to go back the fastest way to your home-airport (= last turn-point into the task-mode).

The first three cases use the following method to solve the task:

In the GPS-receiver the next intended turn-point is invoked with the goal-flight-mode. This function is supported differently in GPS-models: In the GARMIN-receiver the next closest turn-points are displayed through the function "NEAREST WAY-POINTS." The Filser GPS at the "Emergency" function chooses the next flight-places out of the total-list. After activation of the GPS-goal, you wait a moment (about 2 seconds), so that the data is transferred right into the flight computer. Thereupon, by pressing **ENT** and " **+** " for about 1.5 seconds, the hitherto existing assignment is deactivated and the GPS-goal is activated as the next turn-point. In both the cruise mode as well as the final-glide-mode you are directly led on your intended goal. Incidentally, you can go back anytime to your old route by pressing of **ENT** and " **-** " for 1.5 seconds. Naturally the here described algorithm is useful not only in cases with active GPS-linkage, but equally good without GPS-linkage with the difference, that no turn-points have to be inputed, but always the distance on the

respective legs to be programmed. (see chapter 5.4. *Event-examples without GPS-linkage*).

In case 4, in the task-mode with GPS-linkage, by pressing the **ENT** up to the last route and skipping through all the other turn points your home-goal is selected, without inputs to the GPS-receiver.

5.3 Final-glide without active GPS-linkage

The first example demonstrates the application practice-near of the final glide:
The technical handling is already well-known, we will concentrate more on the tactical applications (example final glide) (see fig. 5.3-1: Event-example final glide).
We are flying, with an ASW 20 on the return-flight from the Swäbische Alps to Weiden (EDQW) a triangle-flight, and approaching the Rhein-Main-Danube channel south of Freystadt on a 5400 ft altitude (QFE Weiden). Before takeoff we already had the single leg with its distance pre-programmed.

Fig. of 4.3-1: Event-example final glide
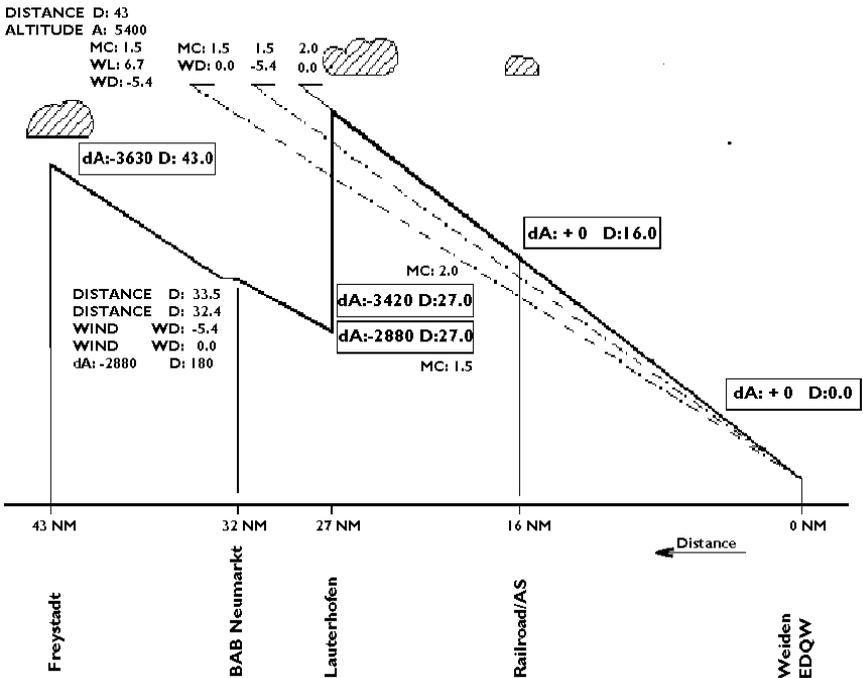
Where the 43 nm distance circle on the map crosses the canal, we start with the final glide. On the right bottom display quadrant already appears the final-glide distance ΔE of 43.0 nm. This is identical with the remaining distance on d3= D3=

43.0 nm. For an exact final glide analysis it is possibly required to correct the 43 nm value (press **KORR** and, **+** or **-**) again and at exact over-flight of the canal (check through lateral control) enter the programmed value by pressing **ENT**. Here we get a first orientation, which wind until now prevailed. We could forget about the altitude value, if during the flight no big pressure-changes are given and our takeoff airport is identical with the destination airport. It is sufficient to compare the displayed altitude with the mechanical altimeter. We can ask the nearby flight service station or air traffic control service, for information about the barometric pressure, using the radio transceiver. If a stronger change during the day is entered, the altitude-correction is performed on the basis of each **0.1 inches of mercury** is equal to **100 ft altitude** change. By international agreement, a standard pressure is defined as having a barometric pressure of 29.92 " Hg (1013.2 millibars) at sea level and with the temperature of 59 ºF (15 ºC). The sea level pressure may vary between the extremes from 28.50" to 30.50" Hg.

We did not observe any major change in wind strengthening, only for safety reasons, we select a head-wind component of 10 knots/h. We retain the MC-value at 1.5. The Glide-path-deviation amounts in our event to dA: **- 3630,** i.e. we are 3630 feet under the required altitude for the final-glide with MC 1.5 and 10 knots/h head-wind-component.

Our tactical-flight considerations aim on two questions:

1. Where can we gain the missing 3630 feet of altitude?

2. Is the estimated wind-component approximately correct?

For the first decision the negative glide-path-deviation it helps to have the following considerations. Can we gain the required altitude in a thermal? Is this possible at all at the present day cloud-base? Do we have a promising cloud street?

We decide for the direct speed-to-fly flight.

Now we must check the wind-influence: A prominent start-line on our prepared map are the 32.4 nm circle at the highway Neumarkt-Regensburg northeastern the place Neumarkt. Until that point we can rely instead on the remaining distance D. If we fly a search-circle, the travel-distance calculation will not be influenced, because in this phase only the wind-shift has an effect. If we forget to activate the thermal/straight flight switch for the following straight flight this will be automatically performed when reaching the speed of 55 nm/hr at the wing-load of 7.2 lbs/sqft as required for the calculation of the remaining distance. We can now focus on the meteorological navigation.

By approaching the mentioned highway of the control-distance, we compare at over-flight with the remaining distance ΔE. It is obvious that the head-wind has died down or is non existent at all, the flight-computer displays D:33.5 nm and not the expected 32.4 nm. So, at the exact over-flight we press the switch(10) to "KORR" position and we correct with the switch (9) to 32.4 nm. Finally we enter the value with switch (10) by pressing it to the "ENT" position. At the same time at the display bottom right section the true wind-component appears, and the top right quadrant displays a blinking

XXXXXX

Now we reduce the wind-component with the "WIND" knob(6). Then the glide-path deviation changes to ΔA: -2880 ft. Above the city of Lauterhofen at 2100 ft altitude above the ground we find a cumulus cloud with 400 ft/min. average lift. In that condition we set the MC value of +2.0 and the newly calculated glide-path deviation displays ΔA: -4320 ft. We can observe while circling in the lift how the ΔA: value is getting smaller.

Finally if the ΔA reaches the value of 0 or a positive value, you can start your final glide in the direction of Weiden. We have plenty of spare altitude for the arrival altitude of 300 ft and 1590 ft at the point where we reset the MC-value to zero. At the double-track railroad Amberg-Sulzbach at ΔA: 90, we check the wind-component again. In case the difference is not too big (+/- .54 nm), we can continue the straight final-glide.

Remark: Display resolution with 0.1 nm interval steps, is very helpful for the distance comparison. It allows the precise adjustment of the controls through interpolation especially for short distances. Besides the generally valid final-glide example we need to consider some special cases:

-Distance flight without preprogrammed distance. In this case for   the final-glide distance there is no value given(ΔE:0) and because   of that no glide-path deviation result. Because of the missing distance entry the computer will request these distances when entering the final-glide mode. After entering the distances, the computer activates these as the last partial-distance(D1) and last leg.

-Flying to a special goal point or (turn-point, ridge, end distance of a thermal-dead weather): You program a complete task. A task with three turn-points. The distance D1 to D4 is programmed. The second leg is 64.8 nm long, and at the distance of 40.5 nm there is a 10.8 nm long valley. You arrive at 8700 ft (QNH) to the valley and to cross over it you would like to use the final-glide mode. The goal is to arrive above the ridge with 600 ft of altitude (the map shows an altitude for the ridge of 5700 ft).
First delete all the remaining distances which do not belong to this route-length. This happens by simultaneously pressing "**ENT**" and "**+**" then all the routes above the active route are deleted. Because of that D3 and D4 fall out in this example. It is now D2= d2= DΣ= ΔE= 24.3 nm (the remaining distance of D2 up to the second turn). You correct the distance of D2 with the intended final glide value of 10.8 nm, because of which all other distance values also change. Additionally, correct the airport-altitude to 6000 ft by pressing "KORR" at QNH-altitude. The altitude is 6000 ft, because 300 ft of arrival-altitude was already integrated. This results in a QFE-altitude of 2700 ft (See 5.3.1: Valley over-crossing: MC: 2.0, WD: -8.1, WL: 6.6). After crossing the valley you reset to the previous task by simultaneously pressing "**ENT**" and "**-**":

- D2 will be set back to 13.5 nm (24.3 nm - 10.8 nm)

- D3 and D4 will be set back to the start-up value
- the FP-altitude will be set back to the original value, because the original goal is the valid goal.

This process may reoccur multiple times.
Furthermore, the following variations are possible:
A final glide to a turn-point is programmed immediately by simultaneously pressing "**ENT**" and "**+**": You want to finish a leg against-wind on a specific altitude, while climbing, you want to use the back-wind-leg, to minimize outlanding-risk, you will keep a certain security-altitude, and you must find thermals on the back-wind-leg on each event. For this case it is possible to use the final-glide-mode. For monitoring the security-altitude there are two possibilities: one, you fly generally on a altitude-difference ΔA, that is equal to the security-altitude (i.e. you must climb that much higher, until you can read at least this security-altitude as a positive value in the ΔA). Two, you set the airport-altitude on this security-altitude and fly with the goal $\Delta A = 0$. You already know that at the end of the turn-point, activate the remaining distance by the simultaneous pressing "**ENT**" and " **-** ", the airport-altitude will be set to the correct value .
- For a flight to a turn-point and back to the last thermal source.
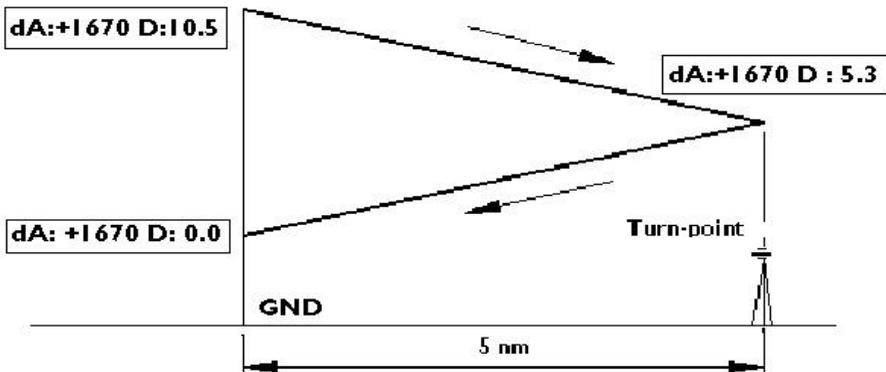
Fig. 5.3-2: Flying on to a turn-point

Example: the distance is 5 nm and your altitude is 4590 ft above ground, you are programming for a glide of 10.5 nm (0.5 nm for the turn-around). The ΔA: the displayed altitude (+300 ft) is then your return-altitude. In our event (Fig. 5.3-2: Flying on to a turn-point)

MC: 2.0; WD: -2.7; WL: 6.75 the results is

ΔA:+ 1670   D: 10.5

With the constant of ΔA other values can be estimated to make sure if your glide path stays within the performance-capabilities of your airplane.

5.4   Final-glide with active GPS-linkage

A comparison between sections 5.3. and 5.4 will assure you that there is practically no major difference in flight with and without active GPS-linkage. The usage is identical, excepting the internal functions, distance programming as such and the total reference-calculations (all distances, over-ground-speeds, wind etc.). In distance programming there is a difference for the task-mode or the goal-flight-mode. In the task mode the calculation of the final glide is always referenced to the entire route up until the last programmed turn-point. While during the goal-flight-mode only the next, or at best, the very next turn-point is acknowledged, so that the final glide can only be predicted up to this point.

5.5   Final-glide in the Task-mode

In the task-mode it is always possible to get the distance to the last goal $\Delta E = D\Sigma$, and at the same time for the selected setting (MC-value, Wing-load value, FP-altitude and wind) the required altitude. If the VW921 is correctly compensated and the above values are set correctly then the negative glide-path difference is equal to the required altitude to be gained by thermalling. So there is no difference when the final-glide mode is invoked, before the start, before the activation of the first leg, in the middle of any legs or during the last leg. It is always a good idea to call-up the final glide mode after down loading the task from the GPS receiver. You can check if the total distance equals the task, this way you have the single turn-point xxx coordinates. In case you forget a turn-point or you entered an incorrect coordinate value then the distance value comparison will be negative. To make the difference clear for a final-glide without GPS receiver, lets assume the same circumstances as in the example in the chapter 5.3. You fly the last leg of the task, around 43.2 nm from the goal Weiden, and you have the same weather condition. You do not need to perform any fine-tuning on the distances, since you have the GPS for that purpose. You know that the readable distance d4 = D4 = DΣ (=ΔE) = 80.4 km from the fourth and last leg, short for the Rhein-Main-Danube channel must be located and

compared to the top-view which the map confirms. The wing-loading, readable in menu-position 0/10, is equal to the true wing-load. Over the radio you acquire the QNH-pressure and if there is a required correction the difference can be input in menu-position 0/2 (by pressing the "KORR" switch twice you can adjust the QNH-pressure directly). In case you did not check the wind-component, in menu-position 0/9 you are able to see the wind set-direction since the last turn point; The difference from the true air-speed TAS and speed over the ground Vg (=ΔV).

XXXXX

Since the wind increased by 3 km/h the ΔV moves between -1 and -6 km/h. You can adjust the wind knob to -5 km/h. The MC selected value remains unchanged on 1.5 m/s.

4.4 Case examples Cruise flight mode

4.4.1 Triangle-flight in the GPS-task mode
empty

4.4.2 Multiple legs and GPS-Goal Flight Mode
empty

4.4.3 Cruise with intermittent GPS-Dropout
empty

4.4.4 Programming of curses with multiple laps
empty

6. Statistics and data-storage

The VW921 flight computer captures and stores all important events of a flight in a data storage. This recorded data is available immediately or later for extensive analysis. The organization of this data storage is in a direct relation to the statistics mode (as to down-loading and printing over the serial interface and getting the flight-data (see chapter 6.3)) so that in this chapter both topics are treated together. To utilize the full potential of the statistics option of your flight computer, a knowledge of its storage-organization is imperative.
 The statistics display mode was already introduced in chapter 3.4.

You might infer that in the *statistics-storage* (agrees with as to the storage of all analyzed flight-data like: route-lengths, average-speed, flight, circling, glide-times, all registers, cruise-distances, and much more) you could recall flight data from a previous flight, however this is not the case, because current and previous flight data cannot simultaneously occupy the data storage.
While the data of a flight is in *record storage* (storage of all events: takeoff, landing, route-start, climb/ glide switch-over etc. are captured) and has not been over-written, it can be loaded into the statistics-storage so that now the flight is in the statistics-storage. What was previously in the statistics storage has now been overwritten. But all to this stored flight data is however kept in the record storage, so that it can be restored later.
The third form of storing flight data is in the *flight-book storage.* The flight book storage holds only short data from the previous 15 flights. It holds the most important flight-book-information like takeoff, landing, and flight time, and the flight date are loaded and displayed. You can familiarize yourself with how the *statistic, record and flight-book storage* interact with each other in the following chapter.

6.1   The VW921 Storage-Memory Organization

For a detailed overview of the VW921 glide-computer data capture the chapter is subdivided into three sub-chapters:

    6.1.1 The Record Storage,
    6.1.2 The Statistics Storage,
    6.1.3 The Flight Log-book Storage.

Chapter 6.1.1 'The Record Storage' is valuable for you only if you would like to have a deeper knowledge of the memory-structure of the VW921. For understanding statistics storage you do not need to read this section. You only need to know that the record storage is dependent on flight duration and a certain number of flights, with all statistic data stores in the background. Using the 'statistics display mode' the stored statistics data can be loaded for these flights into the foreground and analyzed.

6.1.1   The record storage

For reconstruction of the flights for statistics purposes the computer has to store all incidents during the flight with location, altitude, and time. The stored data for each flight includes the following events:

   take-off time,
   landing time,
   the beginning and ending of each part-distance (legs),
   the entry and exit points for thermals,
   the start and end points for each glide (complementary
   to each thermal entry and exit point).

All single events will be stored sequential as raw-data into the record storage memory. A complete flight has the following memory storage structure:

Takeoff	Glide Distance 1	Thermal 1	Glide Distance 2	Start Distance 1	Glide Distance 3	Thermal 2	Glide Distance 4	*	*	*	Thermal m	Glide Distance m+2	Start Distance m+2	Glide Distance m+3	Thermal m+2	*	*	*	Glide Distance x	Landing

Fig. of 5.1.1-1: Structure of the record storage

The record-storage is designed as a 'ring-storage': The storage memory is filled with the flight-data sequentially until the storage is filled-up. The new flight-data will overwrite the first stored data in the beginning of the memory. The record storage capacity is 256 events and it can hold several flights
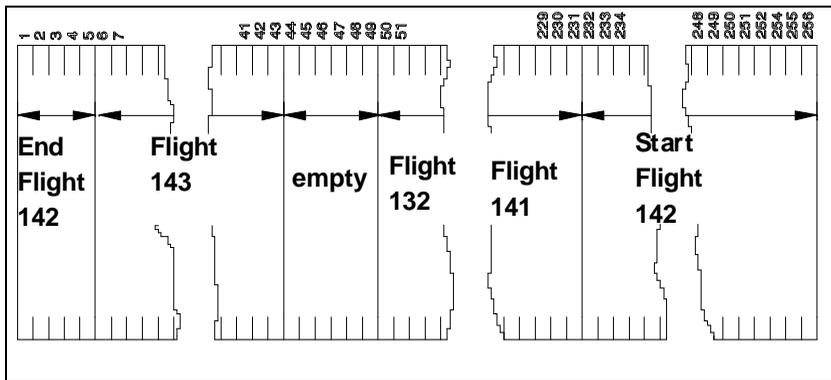

Fig. of 5.1.1-2: Grouping of the flights in the record storage

since even long flights hold only 40 to 50 event records. All flights are stored with complete event records in the record memory, marked with the same flight-number as in the flight-log-book.
For example in the record-storage the flights are marked in the following way:

The last flight is flight # 143, flight #142 reached the end of the record-storage memory and continued to write to the beginning of the memory. The 'oldest' recorded flight was flight #132. The next flight #144, will begin at record #44. The sixth event of the flight is the take-off time, when the events of the oldest flight #132 are
overwritten. Then the whole flight-record is deleted and this part of the memory is freed. The process can be repeated several times during a long flight where the short old flights will be overwritten. Because of this dynamic memory management, it is not possible to define the number of flights which are readable from the statistics analysis.
The largest number of flights is the same as stored in the flight log-book storage(max. 15 flights). With very long flights this number will be reduced accordingly. The record storage is not accessible by the user, you can access the data only through the statistics display mode, thru a printout or downloading it to another computer. You have to load each single flight into the statistics storage memory.

6.1.2   The statistics-storage

With the title "statistics-storage" we cover all data required to process the flight analysis. The statistics storage can always hold only one flight, which is available through the display mode during or after the flight, printable, and downloadable to a PC. A printout or download thru the serial port can only be performed after the flight is finished. The loaded flight data remains in the statistics memory until something is newly loaded. The newest happens automatically at every new take-off, but it is possible to load older flight-data as long it is still available in the record-storage. The last mentioned possibility is only available on the ground, in flight it is locked and the statistics storage is occupied with the current flight data.

In case you are not reloading any earlier flights from the record-

storage memory, the statistics storage holds the data from the last flight. After the flight you are able to connect a printer and print the statistics data of the last flight.
The printing of earlier flights requires the usage of a algorithm (see chapter 6.1.3 The Flight Log-book Storage).

You can access the flight-data stored in the statistics storage memory in three different ways:

- on the display through the statistics menu selections
  (see chapter 3.4),
- printing through the serial port connected printer,
- downloading to a PC through the serial port.

These possibilities are handled in detail in chapter 6.2.

6.1.3   The flight-log-book storage

The VW921 flight-computer is equipped with an integrated real-time clock. This way all the flights are logged with a date and take-off and landing times. The logged time and date enables you to log the flights and the log-book for the sail-plane precisely. The flight-computer has a separate storage area for log purposes, the last 15 flight are logged. The log works on the FIFO (first-in first-out) principle: if the log-buffer is filled with data from 15 flights, starting with the 16th flight, it pushes out the number 1 flight and the new flight will be logged as flight number 15. The flight log-book storage was designed to be big enough to store a large 14 day competition with eventual multiple starts. You will quickly get used to this convenient future. This future relieves you from inconvenient reacquisition of flight data from the contest manager, and all the flight data is stored and separated apart. The log-book is accessible in the statistics menu row 9 in menu-positions "S0/0 - S9/5" and stores the 15 flights in the following manner:

6.1.3.1 The flight-number

In the top-right display quadrant the selected flight number is displayed. Selecting the statistics mode with switch (8) to the "S" position, you enter the last activated flight log area. To move to other logged flights you have to press switch (9) '+' or '-'. The flights are numbered in growing sequence, i.e.: flight number 113 is followed by 114. At the statistics menu position "S9/5" you are able to set the preferred flight number. The setup procedure is only required for the first time. It is recommended that you select the next available number from your sail-plane log-book. To set the flight number select "S9/5" with switch(8) to "S" position, the "MENU" rotary switch to position '9' and the "MC" rotary switch to position '2.5' :

```
C: +0.0    Log 135
Corr. of FlightNr
```

Pressing switch(10) twice to the 'ENT' position you set the number for the last flight to #1.

```
C: +0.0    Log 135
FlightNr    =    1?
```

To set the flight-number to a preferred number, you have to
enter the correction mode by pressing switch (10) to 'KORR'
position. The display will blink with the message 'Flight no: ?'.

```
C: +0.0    Log 135
FlightNr?      135
```

Now by pressing switch (9) to '+' or '-' position you modify and
by pressing switch (10) to 'ENT' you select the preferred start
flight-number for the last flight. All the previous flights will be
renumbered respectively.

6.1.3.2 The flight-date

For each flight-number you can find the flight date in the
statistics menu-position "S9/0" (dd.mm.yy):

```
C: +0.0   Log 135
Date:    12.09.93
```


6.1.3.3 The takeoff-time

For each flight-number you can find the associated take-off
time in the statistics menu-position "S9/1":

```
C: +0.0     Log 135
TakeOff    10:43:01
```


6.1.3.4 The Time of Landing

For each flight-number you can find the associated landing-time
in the statistics menu-position "S9/2":

```
C: +0.0     Log 135
Landing    12:43:01
```

If the flight is still in progress the displayed time is "0":

```
C: +0.0     Log 135
Landing    00:00:00
```

6.1.3.5 The flight time

For each flight-number you can find the associated flight-time in the
statistics menu-position "S9/3":

```
C: +0.0  Log 135
Fl.Time  2:00:00
```

It is available and continuously updated during the flight.

6.1.3.6 Managing the statistics-storage

The additional flight-log-book option is located in statistics menu-position "S9/4".   It performs the statistics control and loading the logged flight-data into the statistics storage area. In chapter 2.2 it was mentioned that in the statistics storage area there is always only one flight-data loaded and analyzed. Selecting "S9/4" during the flight will always display this message:

```
C: +0.9    xLog 135
     no memory
```

The reason is that during flight the present data from the flight occupies the statistics storage area. Selecting and reloading old flight data is not possible at this time. Before take-off or after landing you can find the status of the appropriate flights in this menu position:

 - In cases where data in the statistics storage area is loaded from the
selected flight-number the lower row displays the following:

```
C: +0.0    Log 135
      in memory
```

This information can appear only once, only by the flight-
number presently loaded into the statistics storage area.
Selecting all the other flight-numbers, where the flight-data is
still stored in the storage area (not deleted), you will be asked:

```
C: +0.0    Log 134
      in memory?
```

Answering the question with a "yes" by pressing switch(10) to
'ENT' you load the data from the selected flight-number into
the statistics storage area. The previously loaded data is
removed from the statistics storage area. In cases where the
selected flight was performed a long time ago, the flight-data
maybe overwritten with the new flight-data, then the display
shows in menu-position:

```
C: +0.0    Log 128
      no memory
```

Certainly for early flight numbers the data is not available
either.

Example: the utilization of the statistics storage area:

You fly a large triangle task. For the flight, the computer
assigned flight number 134. The thermals weaken and you are
not able to complete the task. You try to avoid an out landing
risk and you land at a nearby airport. At that airport you have
the opportunity to get an aero-tow back to the home glider-
port before sundown. When returning to the home glider-
port, you would like to analyze the incomplete task. You did
not have the time to printout and analyze
the flight before the tow to the home-port. Flight #134 ended
at the neighboring airport and the take-off for the tow back to
the home glider-port starts flight #135, even if the computer is
turned off! After landing on the home-airfield your computer
finishes flight #135 with nothing but useless data stored during

the tow. Now you are interested on flight #134, the incomplete triangle task. To reach the statistics data for flight #134 you select with switch (8) the 'S' mode, turn the 'MENU' knob to position '9' and the "MC" knob to position '4' (you selected the statistics menu-position "S9/4").
The display shows:

```
C: +0.0    Log 135
     in memory!
```

Pressing switch (9) to '-' position selects flight #134. To make sure, that you selected the right flight number, turn the "MC" knob through positions 0 to 3 and check the flight-date, flight-time for take-off and landing. After re-selecting "MC" position '4' the display again shows:

```
C: +0.0    Log 134
     in memory?
```

Briefly press switch(10) to the 'ENT' position, then the display shows the message:

```
C: +0.0    Log 134
     in memory!
```

Now you are able to browse through the flight 134 data (see chapter 3.4) or you are able to print the same data through the serial port
(see chapter 6.2).

6.2   The serial interface

The flight computer is equipped with a serial interface, for the various communication-assignments that can be used. These assignments include:

- Printing of statistics-data in the statistics-storage
- Printing the flight-data from the last 15 flights
- reception of the GPS-data from a GPS
- downloading turn-point data to the VW921 (as of version D)

- output of the basic data from the flight computer in one second intervals (time, coordinates, variometer signal, altitude) while at flight to a data-recorder with a particular program on a PC or other data recorder.

6.2.1   Printing of the statistics-data

All VW921 computers with the statistics option have a facility for connecting a printer via the serial interface. Any printer which has a V24/V28 serial interface can be connected and used for printing out the statistics data. Suitable cables are available from the manufacturers.

The procedure is as follows:

- After landing turn on the VW910/921 (or leave it turned on).
- The last flight data is in the statistics storage (or load the selected record number for printing).
- Notice that statistics-menu-position 9 selected in the display, then you will print the flight-book-data and not the flight statistics.
- Turn off the printer power switch.
- Connect the serial cable between the VW921 and the printer serial input.
- Turn on power for the printer. The printer handshake will start the printing process.

The flight statistics data is printed, by which all operation steps of the flight computer (statistics-menu, final glide, normal- or route-mode, pages in the display mode). The printing performed in the background mode, and the VW921 is continuously available for other functions.
If second copy requested, the printer stays connected.
Powering the printer off for (> 10 seconds), and repeated power on the computer prints a new copy of the same flight statistics.
And so the printout of a flight looks like:

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```
* Dr.s. Westerboer, Hofhansel GmbH,
Weiden*
-----------------------------------------
 VW of 921- statistics
-----------------------------------------
Date: Thursday, 12. September of 1993
Way of the fly_____
Pilot: _____
Airplane: _____


==========================================
- TIMES-
-----------------------------------------
Flight time total. | 2:00 h / 141%
Route-flight time. | 1:25 h / 100%
Climb-portion.     | 0:25 h /  29%
Glide portion.     | 1:00 h /  71%
==========================================
- ROUTES-               - SPEEDS-
-----------------------------------------
                 |route | TAS   | GS
                 | nm   |knots/h| knots/h
-----------------------------------------
Total-route S.tot| 108.0|  77.2 | 76.2
Route S of 1.    |  64.8|  83.2 | 77.8
Route S of 2.    |  43.2|  68.6 | 74.0
-----------------------------------------
Mc-trip:   87 knots/h Glide-ratio E:   41
==========================================
-  CLIMBS-
-----------------------------------------
                      |          |Thermal-
No.
-----------------------------------------
Altitude-gains total.  |11550 ft |all
```

```
Number of the thermals | 4        |--
Cruise-sections.       | 7        |--
Average Climbs.        |420 ft/s  |all
Maximum Climbs.        |660 ft/s  | 1
Altitude gain w M.max. | 3000 ft  | 1
Max. Altitude-gain     | 3300 ft  | 2
B climbs. dAmax.       |360 ft/s  | 2
==========================================
- THERMALS -- CRUISE-SECTION-
------------------------------------------
        |      | dS| alt | dA |Time | dT
   No   |  nm  |  M|  ft |  ft|  T  |mm:ss
------------------------------------------
Takeoff|  0.0|     |  750|3000|10:43|
G:    1|  0.0|0.0| 1250|3000|10:53|15:00
B:    1|  0.0|3.3|  250|3000|11:08|05:00
------------------------------------------
G:    2|  0.0|0.0| 3750|1800|11:13|05:00
******************************************
Start route 1
******************************************
G:  3|   0.0| 50.0| 4050|1200|11:18|05:00
B:  2|  50.0|  1.8| 2250|3300|11:23|10:00
------------------------------------------
G:  4|  51.0| 29.0| 4050|3300|11:33|20:00
B:  3|  80.0|  1.7|  750|3000|11:53|10:00
------------------------------------------
G:  5|  80.0| 40.0|3750| 150|12:03|05:00
******************************************
Start route 2
******************************************
G:  6|120.0| 30.0|3300| 850|12:08|05:00
B:  4|150.0|  2.5| 750| 750|12:13|05:00
------------------------------------------
G:  7|170.0| 30.0|3000| 750|12:18|25:00
******************************************
Landg|200.0|     | 750|    |12:43|
==========================================
```

```
* Dr.s. Westerboer, Hofhansel GmbH,
Weiden*
```

Fig. of 5.2-1: Expression the statistics of a flight

In the first length of the expression you find a form-part to the registration of general data of the flight. The second part shows all TIMES absolute in hours/ minutes and relatively in percent.

The next length covers the ROUTES and SPEEDS of the single route-lengths and the total-route. In the last display mode of this real reached prints Glide number.

The fourth length includes following data:
- Altitude-gains altogether in all registers
- number of the registers
- number of the Cruise-sections
- Average Climbs all registers
- Maximum Climbs (strongest register) with No.
  the register
- Altitude-gains into the strongest register
- Biggest Altitude-gains with No. the register
- Average Climbs in the register, that the
  biggest Altitude-gains brought

The last length offers an overview all glide and climb-phases of the row to with the most important data.

Cruise-section G:
- number of the Cruise-sections
- Nautical-miles S at the start, covered on the total-route
- completed kilometers dS
- altitude at the start H (Total energy-altitude loudly standard-atmospheric pressure)
- altitude-difference dh
- Time in hours and minutes
- duration of the Cruise-sections in minutes and seconds

 climb-phase B:
- number of the register
- Nautical-miles at the start of the climb-phase, covered on the total-route
- Average M into m Climbs/ s
- start-altitude of the register
- Gained altitude into the register
- Time in hours and minutes
- climb-time in minutes and seconds

Comment: The absolute-information of route S, start-altitude H and Time always cover on the commencement of the circling- respectively itself glide phase, the recorded is with the commencement of the next phase always identical.

6.2.2   Printing the Flight Log-book

The printing the flight-dates, take-off and landing-times of the last 15 flights is analogous to the printing the statistics-storage. It requires the connecting of the serial-printer to the serial-port. The display mode selection is in the statistics menu-row "S9/6": printing the flight log-book. Presently the function is not implemented for the VW921 computer.

6.2.3   Data output format during the flight.

Additional possibility exist to output and store flight-data to an external equipment (like laptop computer or flight recorder) using the serial port.

The TxD-output pin of the female D-sub-connector has to be connected to the serial-port of the recording equipment. The data is transmitted in 4800 baud 8-bit, no-parity mode. Each transmitted block holds the following information:

1	Byte	, **$**- 1. byte for the Synchronization"		
2	Byte	, **R**- data-block- recognition		
3	Byte	Flight-state	Bit = 1	Bit = 0
		Bit of 0		
		Bit of 1	Airplane in the flight	
		Bit of 2	Airplane lands	
		Bit of 3	Speed-to-fly-mode	
		Bit of 4		climb-mode
		Bit of 5		
		Bit of 6		
		Bit of 7		

4-6	3 bytes in BCD-code	Time in hours/minutes/seconds
7+8	Signed Integer Number	total energy compensated standard-.pressure-altitude
9+10	Signed Integer Number	average climbs in the last 20 seconds, multiplied with 10
11+12	Signed Integer Number	exact variometer value, multiplied with 10
13+14		True Air Speed (TAS), multiplied with 10
15+16	Unsigned Integer Number	Compass-course (at option compass-linkage)
17+18	Signed Integer Number	Over-ground-speed, multiplies with 10 (at option compass-linkage)
19+20	Unsigned Integer Number	Course over ground (Track, only at option GPS-linkage)
21-28	Floating-Point-figure	Position in length and width (only at option GPS-linkage)

The numbers are carried over in the following numerical format:

unsigned or signed integer numbers

- consist of 2 bytes
- LSB carried over first

floating-point-numbers
- consist of 4 bytes
1.st byte: Exponent + 080H
2.nd byte: bit 0-6 Mantissa positions 2-8
                 bit 7   sign
3.rd byte: Mantissa positions 9-16
4.th byte: Mantissa positions 17-24

The mantissa position 1 behind the decimal-point is
basically 1

7.   Miscellaneous

7.1   Installation

The glider wiring system must not be live during installation.
Before starting work disconnect the battery.

Warning: Before any electrical connections are made it is
essential that the variometer is **switched off** (i.e.
on/off/volume knob (1) turned fully contra-clockwise).

Both units are designed to standard dimensions so installation
is very easy. There is no need for a compensation bottle
because of the principle on which the pressure sensor works.

It is recommended that the computer be located top left on the
instrument panel or perhaps in the middle so that it is easy to
reach with your left hand. (see Appendix 9.3).
If the compass is mounted in the panel it must be at least 3.2
inches away because of the magnetic field of the variometer. If
the compass is mounted on top of the pedestal i.e. on the
horizontal surface above the instruments there should be no
discrepancies caused by interference.

Tubing connections are made as follows:
   · the pitot is connected to the **DYN**
   · static pressure to **STAT**.
The connectors are at the rear of the VW910 variometer.

The power supply is taken from the glider 12V system:
   · red wire to positive
   · blue wire to negative

If the wires are connected incorrectly and polarity reversed the equipment will not operate. It is protected from reverse polarity damage, but it is prudent to ensure correct polarity in any case.

Then the VW921 computer and the VW910 variometer are connected. The 15 pin connector marked *R* is equipped with a slide-lock and connects to the computer unit. When slid about 0.1 inches to connect, the slide-lock prevents the plug from becoming disconnected. The variometer is connected in the same way. The 15 pin connector to the variometer is marked with a *V*. The slide-lock for securing the connector is mounted on the variometer case.

Next run a wire through to the speed sensor switch. Take care to ensure that it is not laid adjacent to the radio antenna cable. The speed sensor manual switch (SG switch) is best installed closer to hand (e.g. in the control column). In flapped gliders the speed sensor magnetic switch should be fitted in a suitable position next to the flap control-rod. The magnet is to be fitted directly on the flap control rod and its position should be adjustable. The distance between the switch and the magnet should be approximately 0.2 inches. Select the flap position which the manufacturers recommend as the optimum thermalling position. Then adjust the position of the magnet until the computer switches over from speed to fly (N:) to vario (C:) at that flap position. Now the magnet can be secured in position. If a second automatic switch-over position is required a second magnet should be fitted.

Option of external speaker:

The loudspeaker is supplied in a 60 mm diameter round case. For best effect it should be mounted in the side of the instrument pod or in the instrument panel if there is a vacant

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space. Avoid mounting the loudspeaker pointing upwards as it will very soon collect dirt on the cone and the sound will be distorted. The speaker is connected with a 30 inches long lead which terminates in two flat connectors of the same width.

Duplicate instrumentation Option:

For two seaters a second vario is available in 60 mm or 80 mm diameter versions. Electrical connection is via a 79 inch lead which terminates in connectors designed to prevent incorrect polarity.

Finally the electrical connections and the tubing are checked, the battery is connected and the equipment is switched on using switch (1) as described in Section 3, Operation.

Printer/Serial Interface Connection

There is a 9 pin D sub socket on the rear of the VW921 for connecting a printer / personal computer or GPS-receiver via the RS-232 serial interface. The cables supplied include an option of single or double cable connection.
In some gliders the rear of the VW921 will be accessible.

The 9-pin D sub socket connects to the flight computer, the 9-pin D-sub-plug is a one-to-one serial interface extension of the flight computer serial port and serves as the connection to the printer serial port, a personal computer serial port or a data-logger. This plug can be installed on the instrumentation pedestal, providing an easy access for printer or laptop-computer. The other lead of the double cable connects to the optional panel-mount GPS receiver.
Mark the cutout for the plug with help of the included template.
Over this external serial port connection it is not only possible, to speak to the VW921 with a PC, but also to the GPS-receiver. For example you can download to the GPS-receiver with all turn-points from the PC.

Attention: If over this plug a third unit, i.e., a printer or a PC, is installed, the unused instrument must be turned off. Only two active accessories can be linked simultaneously with each other. While connecting a printer to the flight computer, the GPS-receiver must be powered off. While connecting a PC to the GPS-receiver the VW921 flight computer must be powered off. A suitable cable for connecting a PC to the flight computer is a 9 pin cable of the RS 232 type.
The same cable is also suitable for the PC to the GPS-receiver connection. For this connection any 1:1 RS-232 cable with 9-pin D-sub-connector is usable.

In gliders with accessible connectors to the VW921, the single-lead cable-set will be used. The connection to the printer will be established immediately before printing.

If direct access to the rear of the VW921 is not possible, the double-lead cable should be used. The part with the 9-pin D-sub plug must be installed solidly. The D-sub-plug of the VW921 should be connected and locked. The 5-pin round female connector should be mounted in a reachable place in the airplane (e.g. Instrument-panel). The other cable included with the VW921 is for connection to the 5 pin round female connector to the serial device (i.e. printer or PC). Also see chapter 6.2. , Serial interface.

7.2   Compensation

We have had no reports of pilots finding compensation a problem. Test bench adjustment has proved itself in practice. In cases where there were unsatisfactory pitot results the electrical compensation was working well.

However meticulous test bench adjustment may be, a check is needed in the aircraft itself to detect any minor errors in static pressure or measured pressure. This can only be carried out on a test flight of course. There follows a description of the pull-up case (converting speed to height) as it is relevant to cross country flying.

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This test requires stable weather with an absence of thermal activity if possible. The test sessions are always started at a fixed initial speed V1 leg. as in Fig. 8 at 92 knots). The test consists of rapidly reducing the speed to a lower speed V2 leg. 49 knots) by easing back on the stick. To avoid acceleration effects the change in direction of flight should be smooth rather than sudden.

During the transition from V1 to V2 the variometer display is observed. Ideally the display would follow the aircraft polar exactly (continuous line (1) in Fig. 8), but there may well be small deviations in the transition phase (dotted line). In this phase the angle of attack and the coefficient of lift changes. Naturally this also affects the drag coefficient. Consequently it is generally not possible to avoid a small deviation from the ideal when conducting flight tests.
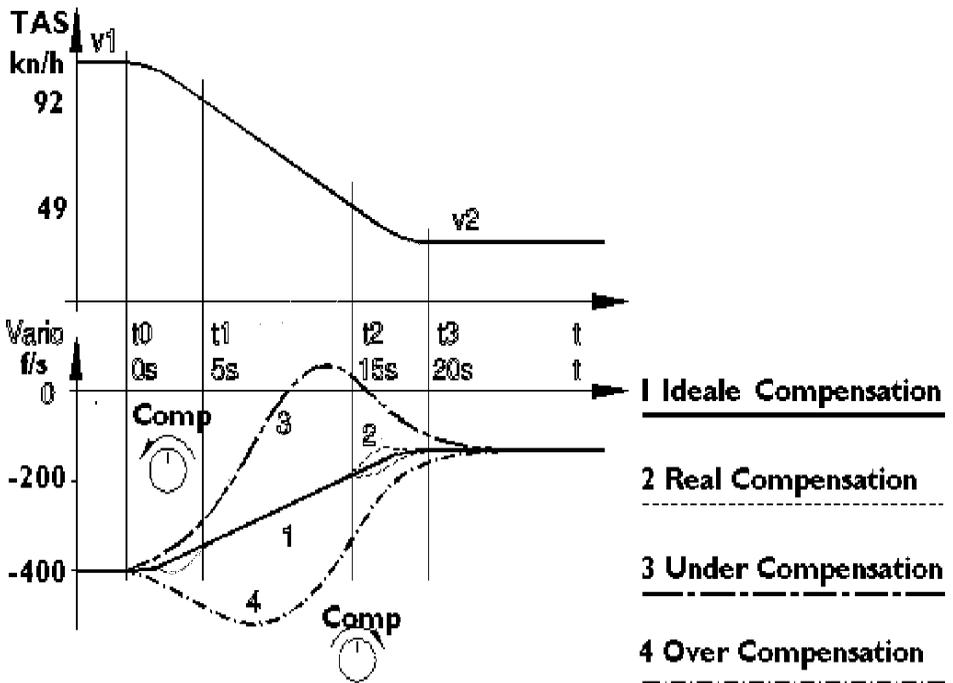
Fig. 7.2-1: Total-energy-Compensation

If you have reason to believe the compensation to be in adequate then the cause may be the static pressure source. We have had good results with pressure taken from a tube at the rear of the fuselage which is used purely for the variometer. The pitot tubes which some manufacturers build into the fin as standard have proved to be excellent.

You can also adjust compensation (2) at the vario itself. Using this adjustment, compensation can be set during the test flight. To do this you do need however to recognize the possible errors which may be displayed and be able to interpret them. Fig. 8 represents typical errors and these can be recognized and corrected as follows:

- Variometer reading rises when you pull back on the stick and shows too little sink or even shows climb.
    It is tending to operate like an uncompensated variometer (dashed line (3) in Fig. 8). The cause is too little compensation. Compensation is increased by turning the compensation adjustment knob (2) anti-clockwise.
- The vario reading falls off when the stick is pulled back and during the transition from V1 to V2 continues to show exaggerated sink values (dashed/dotted line (4) in Fig. 8).
    The cause is excessive compensation. The cure is to turn the compensation adjustment (2) in a clockwise direction.

NB. This adjustment is sensitive: even small movements affect the degree of compensation considerably.

7.3 Compass Compensation

 (Only for flight computers with optional compass-linkage! Not yet available.)

7.4 Selecting the Glider Model and its Polar

Your VW921 glide computer stores the polar for a wide variety of gliders in its memory. Selecting the glider model automatically sets the correct polar. In cases, where your glider model is missing from the list, you can select a glider model with a similar polar. The resulting error for the speed-to-fly value is minimal. The pre-programmed glider-models stored in the VW921 memory are
listed in table 7.4.1. Selecting the glider model is performed in the following manner: Within the first 10 seconds after powering-on the VW921 and the display shows the presently selected glider-model, press switch (10) to the "**KORR**" position, programming mode is then selected. It is dependent on the menu selector knob position which glider manufacturer group is displayed for 2 seconds. To select a different glider manufacturer group you have to rotate the menu selector knob (4) and with the toggle-switch (9) press +/- to select the glider-model. To enter the selected glider model, press switch (10) to the "ENT" position. For each glider model there are three polar curves:

1. The normal polar is the optimal polar curve.
   The polar selector switch(7) is in **P0**, the mid-position.
2. The bug-infected polar, takes a linear degradation from
   the normal polar. 5% degradation at 43 nm/hr. and 10% at
   86 nm/hr. Switch(7) position for the "bug-polar" is **P1**.
3. The rain polar takes more degradation from the normal
polar.
   15% at 43 nm/hr. and 30% at 86 nm/hr.
   Switch(7) position for the "rain-polar" is **P2**.

In case you find the degradation higher then the "rain-polar" you can select a polar from a glider with lower performance.

To do that during the flight, turn off the power of the VW921 briefly and choose a different glider model. If the power-off period was shorter than 1 minute, the computer will keep the collected data, it will not reinitialized.

Manu-facturer	Akaflieg-Gliders	Glazier-Dirks 1)	Glass-flügel	Grob	Polish Gliders	Rolladen Schneider
Menu Knob	0	1	2	3	4	5
	D38	DG100	Lib301	AstiCS	Cobra	LS1c
	D39b	DG100C	GF304	JeansA	Jant1	LS1d
	D40	DG200	GF402	ClubAs	Jant19	LS1f
	SB5	DG217	GF604	SpeedA	Jant2	LS3
	SB9	DG300	Hornet	TwinAS	StdJan	LS3a
	SB11	DG400	Kest19	Twin3	SZD55	LS3-17
		DG417	Kest22		SZD56	LS3Std
		DG518	Mosqui			LS4
		DG520	StdLib			LS6
		DG600				LS7
		DG617				LS8
		DG618				LS9
		DG800				