

# VW 1000/1010/1020 Electronic Variometers

## Operating Instructions



Dr. rer. nat.  
Westerboer,  
Hofhansel  
& Cie GmbH

VW1000 Operating Instructions  
Date of issue: April 2010, V1.03

© Dr. Westerboer GmbH

Dr. Westerboer GmbH  
Pröblstraße 18  
D-92637 Weiden

Phone: 0961-26916  
Fax: 0961-6342055

[www.westerboer.de](http://www.westerboer.de)  
[mailto@westerboer.de](mailto:mailto@westerboer.de)

# Contents

1	Installation	1
1.1	Introduction	1
1.2	Scope of Delivery	2
1.3	Installation of the Variometer VW10xx	2
1.4	Connections	3
2	Operation	5
2.1	Switching-On	5
2.2	Setting the Sound Level	5
2.3	Buttons SET, +, -	5
2.4	Parameter Sequence of the Main Menu	6
2.5	Screen	7
3	Configuration	9
3.1	Overview of Configuration VW1000	9
3.2	Overview of Configuration VW1010 and VW1020	10
3.3	Scaling and Units	12
3.4	Altimeter	12
3.5	Speed Command	13
3.6	Electronic Compensation	14
3.7	Further Configuration Parameters	16
4	Auxiliary Equipment	18
4.1	Repeater VW1050 und VW1060	18
4.2	External Loudspeaker	18
5	Technical Data	19



# 1 INSTALLATION

## 1.1 INTRODUCTION

The instruments VW1000, VW1010 and VW1020 of the new Variometer series feature a compact design, a simple handling and the Westerboer-specific Variometer characteristics.

Display of the vertical speed is effected by means of a needle in a classic round instrument and can therefore be very well read under any lighting conditions. The instruments VW1010 and VW1020 are additionally equipped with a graphic LCD display. There a medium climb, altitude indications, the real flying speed, temperature and battery voltage can be faded in.

Due to the global approval by the aircraft manufacturer's entry into the flight manuals, the Variometers of this series are appropriate for gliders. If altitudes and flying speeds are indicated, these are only supplements of the approved mechanical instruments and shall not replace them in any case.

The principal characteristics of the three instrument types are:

### **VW1000**

- TEK-compensated E-Vario

### **VW1010**

- TEK-compensated E-Vario
- Averager

### **VW1020**

- Electronically compensated E-Vario
- Averager
- Speed command

If in the following text Vario VW10xx is mentioned, the text applies to all three types VW1000, VW1010 and VW1020

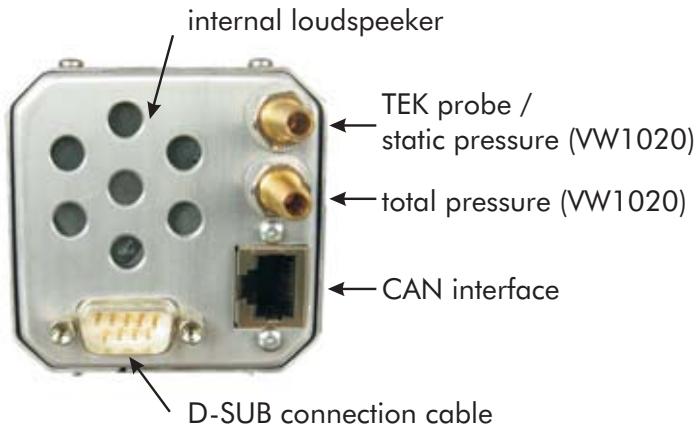
## 1.2 SCOPE OF DELIVERY

- VW10xx E-Variometer
- - speed command / Vario changeover switch (only VW1020)
- temperature sensor (only VW1010 and VW1020)
- integrated loud speaker (in addition an external loud speaker is available)
- cable for 12 V power supply
- installation material

## 1.3 INSTALLATION OF THE VARIOMETER VW10xx

The Variometer is installed in a standard round cut-out of 57 mm in diameter. The used screws shall not extend more than 15 mm into the instrument.

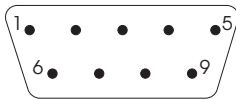
When opening the cockpit canopy while the sun is at a high position, please bear in mind that the display might get damaged by its burning glass effect.



# 1.4 CONNECTIONS

## Pneumatic Connections

The connections are carried out as shown in the figure. The TEC nozzle is plugged in the upper hose clip. At the VW1020 generally the static pressure is plugged in here (electronic compensation). It is however also possible to connect the VW1020 to the TEC nozzle (please adjust the configuration). This requires however that the coefficient of the TEC nozzle – a nozzle specification characteristic - is exactly 1 (one), as otherwise the speed command would not work correctly. In case of the VW1020 it is generally recommended to use the static pressure reduction. If necessary the compensation may then be adjusted to the configuration. There is a second hose clip for the total pressure at



pin assignment, seen from the solder side of the cable bushing

Pin	Cable	VW1000	VW1010	VW1020
1	battery +12V	✓	✓	✓
2	temperature sensor	✗	✓	✓
3	temperature sensor	✗	✓	✓
4	external loudspeaker	✓	✓	✓
5	external loudspeaker	✓	✓	✓
6	batterie earth	✓	✓	✓
7				
8	speed command / Vario switch	✗	✗	✓
9	speed command / Vario switch	✗	✗	✓

the VW1020.

## Electric Connections

The electric connections for the power supply, the optional external loudspeaker, the temperature sensor (VW1010/VW1020) and the speed command / Vario change-over switch (VW1020) are connected to the plug of the D-SUB connection cable. The delivery of the instruments includes a suitable connection cable. Modifications can be carried out by experts while observing of the pin assignment. The speed

command / Vario changeover switch at the VW1020 may be a mechanical switch or a magnetic switch at the air brake leverage of the flapped glider. When the switch is open, the VW1020 is in Vario mode, when it is closed it is in speed command mode.

**Attention: The 12 V power supply may only be connected to the herefore provided pins of the D-SUB bushing. Otherwise the instrument might get damaged! Please also pay attention to the correct polarity!**

### **CAN Interface**

For communication between the different Westerboer instruments the CAN-bus has been selected, a bus having been developed for the motor industry and featuring high transfer rates and a data transfer insusceptible to interference. Besides a RJ45 bushing has been installed at the VW10xx providing in addition to the data a 5 V power supply for connected components. The components provided herefore (presently: auxiliary display units VW1050 and VW1060) are connected by means of a standard patch cable with a wiring 1:1.

# 2 OPERATION

## 2.1 SWITCHING-ON

The VW10xx does not dispose of a separate closing switch. Switching on is effected by installing the 12 V power supply of the on-board battery. Normally in the planes a separate switch is integrated in the instrument panel applying the on-board voltage to the avionics. Thus we could renounce of a separate closing switch for the VW10xx for the benefit of a compact design. After finishing the flight you should however switch off the Vario (power-off) for avoiding a discharging of the battery in the long run.

## 2.2 SETTING THE SOUND LEVEL

During normal operation the sound level can be increased in 9 steps by pressing button "+". By pressing button "-" it is reduced step by step. The lowest step turns off the audio.

## 2.3 BUTTONS SET, +, -

After activating the VW10xx automatically starts in the Vario mode. Parameters can be modified when selecting a menu by means of the "SET" button. When repeatedly pressing the "SET" button, you leaf through the different parameters of the VW10xx. You can then modify the parameter values by pressing button "+" resp. "-". When returning to the Vario mode, the modifications will be permanently saved.

The VW10xx automatically returns to the Vario mode after a short time (approx. 15 s) so that it is not necessary to select again the Vario mode after having modified a parameter.

The last parameter in the sequence of the main menu is "Config". After acknowledging this parameter by pressing button "+" you go to the configuration menu. Parameters for editing basic instrument settings that normally must not be modified during a flight are located there.

## 2.4 PARAMETER SEQUENCE OF THE MAIN MENU

The parameter sequences of the three instrument types vary and are specified in the following tables. Here only parameters of the main menu are described whose values even during a flight have to be modified occasionally. Parameters that normally have to be set only one-time are located in the configuration menu and are described later on.

For guiding through the parameter sequence of the instruments VW1010 and VW1020 their names are shown on the display. Above that the corresponding actual parameter value is indicated. As the VW1000 is not equipped with a display, the guiding is effected by needle deflections. At first the needle points to the negative range for displaying the parameter number and then changes to the positive range for showing the actual value. In order to be able to represent an adequate value range, half scale steps are applied. For example a needle deflection first towards -1 (Parameter No 1) and then towards +1 (=2 half steps on the scale) means: a medium damping is set.

The actual values can be modified by pressing button "+" resp. "-".

### Parameter Sequence VW1000

Parameter	Nr.	Value Range	Note
Damping	1	1 .. 3	Variometer damping; 1: low damping 2: medium damping 3: high damping
Config	2		When acknowledging with button "+", you go to the Configuration

## Parameter Sequence VW1010

Parameter	Value Range	Note
Avg s	2 .. 120 s	Integration time in seconds
Damping	1 .. 3	Variometer damping; 1: low damping 2: medium damping 3: high damping
Config		When acknowledging with button "+", you go to the Configuration

## Parameterfolge VW1020

Parameter	Value Range	Note
MC m/s	0 .. 6	MacCready Einstellung für Sollfahrtgeber in Schritten zu 0.5 m/s
Avg s	2 .. 120 s	Integration time in seconds
Damping	1 .. 3	Variometer damping; 1: low damping 2: medium damping 3: high damping
WingLoad	20 .. 50 kg/m <sup>2</sup>	Wing load; adjustable in steps of 0.5 kg/m <sup>2</sup>
Config		When acknowledging with button "+", you go to the Configuration

## 2.5 SCREEN

Following specifications refer to the instrument types VW1010 and VW1020, both equipped with a LCD display.

### Status Display when Switching-on

D When being switched on, on the display the instruments VW1010 and VW1020 show information on the serial

number of the instrument, the scaling and the unit of the Vario display.

### Screen Layout

In central position and in clearly bigger letters the medium climb is digitally displayed and marked with an "M" put in front. In case of the VW1020 here in the speed command mode the actual air mass climbing (Net vario) is displayed, marked with an "N" being inversely displayed for a better identification.

Above and below the display of the medium climb, there are two parameter lines on the display that the user can program. The corresponding parameters in the Configuration are "Top" and "Bottom". You can select all altitude indications (STD, QNH, QFE) in foot and meters, temperature (°C and F), the battery voltage and in case of the VW1020 additionally the flying speed (TAS).

Furthermore in case of the VW1020 the MacCready Value is faded in on the bottom line.



# 3 CONFIGURATION

As mentioned before, parameter "Config" is located at the end of the main menu. When acknowledging with button "+", you go to the Configuration menu. By pressing button "SET" instead, you go back to the Vario mode.

If you don't press any button for approx. 30 seconds, you will automatically leave the Configuration menu and return to the Vario mode. Also a manual change is possible. For this keep button "SET" pushed until parameter "Main" appears on the display. After acknowledging with button "+", you return to the Vario mode. If parameters have been modified in the Configuration menu, you must change to the Vario mode. Only then, modified parameters will be permanently saved in the internal memory. If the power supply had been interrupted before, the original values are maintained.

## 3.1 OVERVIEW OF CONFIGURATION VW1000

As VW1000 is not equipped with a display, the actual parameter and its value are indicated by the needle position – like in the main menu. Here also half steps are applied. After the actual value has been indicated that way, it can be modified by pressing button "+" resp. "-".

Parameter	No.	Value Range	Note
Volume	3	0 .. 8	Volume when switching on 0 = Audio off; 8 = max. volume
Units	4	0, 1	0=m/s; 1=kts
Range	5	0 .. 2	0=0..3; 1=0..6; 2=0..12
Main	6		Go to the main menu by pressing button "+"

## 3.2 OVERVIEW OF CONFIGURATION VW1010 AND VW1020

In case of the instruments VW1010 and VW1020 the parameters are shown on the display.

### Parameter Sequence VW1010

Parameter	Value Range	Note
LCD	0 .. 63	0=light display; 63=dark display
Elev m	0 .. 2000 m	Altitude of the takeoff place MSL
Units	m/s, kts	Unit of the Variometer display and the averager
Range	0..3, 0..6, 0..12	Display range of the round scale
Top		Parameter shown at the top
Bottom		Parameter shown at the bottom
Volume	0 .. 8	Volume when switching on 0 = Audio off 8 = max. volume
Main		Go to the main menu by pressing button "+"

### Parameter Sequence VW1020

Parameter	Value Range	Note
LCD	0 .. 63	0=light display; 63=dark display
Elev m	0 .. 2000 m	Altitude of the takeoff place MSL
Units	m/s, kts	Unit of the Variometer display and the averager
Range	0..3, 0..6, 0..12	Display range of the round scale

Parameter	Value Range	Note
Comp	-100 .. +100	Percentage deviation from the coefficient 1
Probe	static, TEK	Depending on the pressure at the upper pneumatic tube
STF Ptr	STF, Netto	In the speed command mode: STF=needle indicates the speed command Net = needle shows net climb
STF km/h	60 .. 300	Threshold for speed-dependent speed command switch-over
Top		Parameter shown at the top
Bottom		Parameter shown at the bottom
Volume	0 .. 8	Volume when switching on 0 = Audio off 8 = max. volume
v1 km/h	10 .. 300	for determining the polar curve
w1 m/s	-4.0 .. 0.0	for determining the polar curve
v2 km/h	10 .. 300	for determining the polar curve
w2 m/s	-4.0 .. 0.0	for determining the polar curve
v3 km/h	10 .. 300	for determining the polar curve
w3 m/s	-4.0 .. 0.0	for determining the polar curve
WL kg/m2	10 .. 50	for determining the polar curve
Main		Go to the main menu by pressing button "+"

### **3.3 SCALING AND UNITS**

For the international use, the Variometers VW10xx can indicate the climb in meters per second as well as in knots. Switching over is effected in the configuration menu. The scaling must then be adjusted accordingly in order to be able to show a reasonable value range.

On delivery, the standard setting of the unit is meters per second and of the range 0 to 6 m/s. Thus a scale division corresponds to one meter per second.

At the setting 0 .. 3 the VW10xx operates as precision variometer with 0.5 m/s per scale division. For being able to monitor the selected unit and the value range, the actual settings of these parameters are shown on the display of the VW1010 and the VW1020 when being switched on.

### **3.4 ALTIMETER**

The VW1010 and the VW1020 can show the flying altitude on the display. Here all general reference menus (STD, QNH, QFE) and the units "Meters" and "Foot" can be selected. The setting is effected in the configuration by means of the parameters "Top" and "Bottom".

For QNH and QFE the altitude of the takeoff place above MSL must be entered in parameter "Elev m" before takeoff. If you always take off at the same place, value input must only be effected once.

The VW1010 is characterized by the fact that it is exclusively connected to the TEC nozzle. The herewith measured pressure corresponds to the static pressure in the flying altitude, less the impact pressure<sup>1</sup>. If you calculate the flying altitude hereby, different values depending on the flying speed will result, always misleadingly overvaluing the altitude. For obtaining reasonable altitude indications, in case of the VW1010 a constant is deducted from the measured value so that the correct value will result at a flying speed of 120 km/h. If you fly more slowly, the indicated altitude is lower (approx. 30 m at 85 km/h). As a result the indicated altitude will be higher at higher speeds (30 m at 150 km/h).

If the VW1020 is also connected to the TEC nozzle, the static pressure is calculated along with the value of the total pressure. Therefore the altitude must not be corrected.

### 3.5 SPEED COMMAND

In case of the VW1020 you can change from the vario mode to the speed command mode (STF Speed to Fly) by means of a changeover switch. Generally the changeover switch is mounted as toggle switch at the stick. Optionally you can mount a magnetic switch at the air brake leverage in case of a flapped glider so that changeover is effected automatically when modifying the flap position.

It is however also possible to regulate the changeover automatically depending on the flying speed. For this you can pre-select the threshold for the automatic changeover by means of parameter "STF km/h" in the configuration. If the flying speed is higher than the threshold speed, the VW1020 will initiate the speed command mode. If you fall below the threshold speed by more than 5 km/h, the automatic system of the VW1020 will switch back to the vario mode.

Switch-dependent and automatic changeover is logically linked with an OR function. If at least one of these two options is in speed command position, also the VW1020 will operate in the speed command mode. If you want to renounce of the automatic system, you have to leave the threshold speed at the maximum value of 300 km/h, that normally will not be exceeded. If you want to fly always in the automatic mode, you must leave the mechanical changeover switch in the vario position or generally renounce of mounting a switch at all. Then an open contact at the D-Sub plug is equivalent to the vario mode of the mechanical changeover. In our experience the mechanical option is preferable as you can herewith avoid any frequent unintentional changeover when flying at a speed around the threshold. The pilot should however decide himself which method he prefers.

The speed command depends on the true descent of the plane at a determined speed and the expected climb in the following thermal. The true descent is taken from the polar curve of the plane (entering the polar curve of the plane is specified in the following), which applies to a determined wing load, and the expected climb is entered as MacCready Value.

If for the speed command mode the display has been selected as speed command (parameter "STF Ptr"), you must

fly more slowly (pull), when the needle deflects up-scale, and you must fly faster (push) in case of negative values. The audio behaves analogically hereto.

In case of the speed command mode, instead of the medium climb the actual climb of the flown through air masses are shown digitally on the display, marked with an inversed "N". Thus you obtain information on the vertical speed of the air mass independent of the flying speed, making easier a decision on getting into the thermals at any speed. Instead of the speed command signal, the net vario can be applied directly on the needle (parameter "STF Ptr" to "Net"). The audio will then continue working as speed command.

For enabling a proper functioning of the speed command mode, the polar curve of the plan must be entered. Generally this is done by entering three pairs of values of the polar curve, consisting of the flying speed and the assigned polar descent. Using the quadratic approximation, you can calculate the polar descent for the complete relevant speed range with the required accuracy.

We recommend selecting the three pairs of values at the speed of the least descent ( $v_1$ ), at the speed of the best gliding ( $v_2$ ) and at a much higher speed ( $v_3$ ) that is generally rarely exceeded during the flight. The values set in the parameters " $v_1$  km/h", " $w_1$  m/s", " $v_2$  km/h", " $w_2$  m/s", " $v_3$  km/h", " $w_3$  m/s" are correspondent. Each polar curve applies to a determined wing load. The wing load of the used polar curves is entered in parameter "WL kg/m<sup>2</sup>". On delivery one polar curve for planes like ASW19 is preset.

During the flight only the MacCready Value and the actual wing load must be entered as parameter in the main menu.

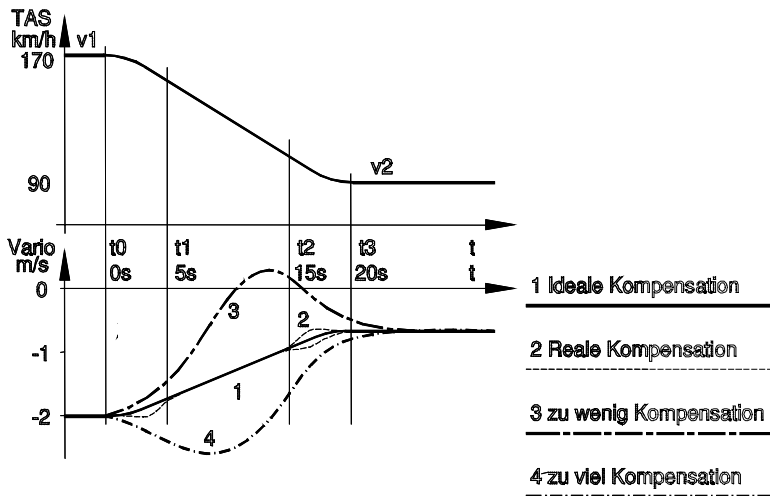
### **3.6 ELECTRONIC COMPENSATION**

The VW1020 does not require any TEC nozzle for a total energy compensated operation. The compensation is calculated from the measured values of the static and the total pressure. According to all existing reports, the compensation does not raise any trouble. Even where often unsatisfying results had been obtained with a TEC nozzle, the electronic compensation is working well.

Optimum values of the variometer are achieved, when the modification of the static pressure caused by altitude loss when gliding forward, is compensated by the impact pressure of the flying speed. In case of a TEC nozzle you speak of a coefficient "1". The VW1020 is programmed in such a way that the pressures are compensating themselves similarly.

In case of deviations from the exact ratio of the pressure modifications, you must adjust the TEC nozzle - for example by modifying the measuring holes. It is of course much easier when using software. In VW1020 herefore parameter "Comp" is adjusted. In case of overcompensation, parameter "Comp" is modified to negative, in case of undercompensation to positive.

You can check the compensation by means of test flights in calm air without thermals. Little measuring pressure reduction errors can be compensated. In practice the "pitching up" is relevant.



The measuring flights always start with a fixed starting speed (e.g.  $v_1 = 170$  km/h as in the figure). Then for avoiding acceleration impacts quickly pitch up with a big radius to a lower speed  $v_2$  (e.g. 90 km/h).

Ideally the variometer display exactly follows the polar descent (line 1). In case of an under-compensation, the number of vario deflections to the positive (line 3) rises. In

case of an overcompensation, there are deflections to the negative (line 4).

Errors are mostly caused by unfavorable pressure drops of the static pressure. Normally good results are achieved by means of a static pressure reduction at the fuselage. Multiple nozzles (Prandtl-Tube) are most suitable, being able to reduce the static pressure as well as the total pressure at the steering gear.

### 3.7 FURTHER CONFIGURATION PARAMETERS

In the following, further configuration parameters are specified.

#### Volume

By means of parameter "Volume" you can preset the volume at which the audio starts when switching on the Vario.

#### LCD

By means of parameter "LCD" you can set the display contrast. The standard value is 32. In case of lower values, the display will get paler, in case of higher values it will get darker. In case of a connected auxiliary display VW1060 its display is being adjusted similarly.

#### Top, Bottom

These parameters determine which data are shown in the top and in the bottom line of the display. You can select among following data:

Value	Meaning	VW1010	VW1020
--	No display	✓	✓
STD m	Standard altitude in meters	✓	✓
STD ft	Standard altitude in feet	✓	✓
QNH m	Altitude MSL in meters	✓	✓
QNH ft	Altitude MSL in feet	✓	✓

Value	Meaning	VW1010	VW1020
QFE m	Altitude above take-off place in meters	✓	✓
QFE ft	Altitude above take-off place in feet	✓	✓
TAS kmh	True air speed in km/h	✗	✓
TAS kts	True air speed in knots	✗	✓
T C	Temperature in °C	✓	✓
T F	Temperature in Fahrenheit	✓	✓
Bat V	Battery voltage in Volt	✓	✓

# 4 AUXILIARY EQUIPMENT

## 4.1 REPEATER VW1050 UND VW1060

At present auxiliary display units are available. The VW1050 is a pure needle instrument whereas the VW1060 disposes of an additional LCD where the same parameters are displayed as in the instruments VW1010 and VW1020.

Both auxiliary display units are connected to the RJ45 bushings (CAN interface) of the VW10xx Variometer by means of a patch cable. In addition to the data, this cable is also in charge of the power supply of the instruments VW1050 and VW1060. Therefore no additional power supply is necessary.



The scaling and the units of the needle are taken over when switching on Variometer VW10xx and in case of type VW1060 they are shown on

the display for a short time. When modifying parameter lines "Top" and "Bottom" of the VW1010 resp. VW 1020, these modifications are transferred to the VW1060 and also carried out there.

## 4.2 EXTERNAL LOUDSPEAKER

An external loudspeaker is recommended in case of dual seaters and planes whose instrument housing is closed all around.

## 5 TECHNICAL DATA

Cut-out in the instrument housing	57 mm standard cut-out
Housing dimensions	W = 60 mm H = 60 mm L = 98 mm
Weight	approx. 200g
Supply voltage	9 .. 18 V
Power input	90 mA at a medium sound level





