# LARUS Vario Display

## *Installation and User Manual*

Version v0.4.1.0


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## About This Document

This manual describes the LARUS Vario Display, which can be obtained from SteFly (stefly.aero). This manual also refers to other devices from this manufacturer. The software for the Vario Display is available under an open source licence and can be used on various devices.

## Software Licence Agreement

This software is released under the GNU General Public Licence, version 3. The full text of the licence and the disclaimer can be found on this page: gnu.org/licenses/gpl-3.0.

## Disclaimer (Vario Display Software)

This product, together with all associated files, data and materials, is provided ‘as is’ and without any express or implied warranty. Use of this product is at the user’s own risk. Although every effort has been made during development to eliminate errors, no guarantee of freedom from errors is given. No claims are made regarding its accuracy, reliability or suitability for a particular purpose. The developers and contributors to the Larus project shall not be liable for any errors contained herein or for incidental or consequential damages, loss of data or personal injury arising out of the provision, performance or use of this material.

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# 1 General Information

## 1.1 Preliminary Remarks

### 1.1.1 Important Information

Before using the system or any part of it, please read these instructions carefully and familiarise yourself with them.

### 1.1.2 Conventions and Definitions of Pictograms

The safety instructions are based on risk assessments and hazard analyses. In this document, the following symbols are used:

Please take note of the important instructions marked with a yellow warning symbol, as failure to follow them may result in damage or other critical situations.

A blue cloud indicates useful information or tips.

## 1.2 Safety

### 1.2.1 Safety Precautions

Duty to inform: Anyone involved in the installation or operation of LARUS components must read and observe the safety-related sections of this operating manual.

### 1.2.2 Intended Use

The LARUS Vario Display visualises data that is measured and calculated by the LARUS sensor unit. LARUS was developed to calculate the direction and strength of thermals and wind quickly and reliably. To do this, the sensor unit combines data from high-precision sensors and GNSS receivers using sophisticated algorithms. The LARUS Vario Display is installed in the instrument panel. The LARUS sensor unit provides glider pilots with accurate information on wind, vertical air movements and the attitude of the glider. Its use is restricted to daytime VFR conditions. Safety decisions must be made independently of the installation and operation of the LARUS components .

### 1.2.3 Improper Use

Any misuse will invalidate all liability and warranty claims. Misuse is defined as any use that deviates from the purposes stated above, in particular:

- The use of LARUS data under non-VFR conditions or at night is prohibited. LARUS is not certified for such use. Although LARUS supplies AHRS data to XCSoar, you should not rely on the artificial horizon display.
- Use of LARUS data during aerobatics or under flight conditions involving high angles of attack (stall) or high G-forces. The algorithm has been designed for normal flight conditions.
- Operating the LARUS Vario Display outside the conditions defined in the technical specifications , such as high or low supply voltage, excessive temperatures or humidity.

# 2 Installation

## 2.1 Contents of the Package

The following items are included:

- LARUS Vario Display
- Mounting screws
- 1:1 standard RJ45 cable
- Micro SD card with adapter
- D-Sub 9-pin solder-in connector and housing
- 1.5 mm hex key for fitting the rotary knobs

## 2.2 Quick Start Guide

In some cases, the default settings can be used and the device can be put into operation in a simplified manner. In such cases, it is sufficient to observe the following points:

1. Please remove both knobs using a 1.5 mm hex key (included in the scope of delivery).
2. Secure the LARUS Vario display with three screws in a 57 mm recess in the instrument panel. It can also be mounted rotated by 90°, 180° and 270°.
3. Fit both rotary knobs
4. Connect the CAN port of the LARUS Vario display and the LARUS sensor unit using the 1:1 patch cable included in the delivery.
5. Switch on the LARUS.
6. Check that the satellite icon on the screen is yellow or green and that the current heading is displayed.
7. Select a suitable polar curve for your glider or create one.
8. Your LARUS Vario Display is now ready for flight.

## 2.3 Design and Function

The LARUS Vario Display shows the data measured and calculated by LARUS. LARUS is an advanced variometer with a real-time wind measurement function. It features state-of-the-art pressure sensors, an advanced IMU and GNSS receivers to capture precise flight data. The key features of the display are:

- Round display for standard 57 mm instrument panel cut-outs
- Bright and colourful screen
- Lightweight, compact design with black anodised aluminium housing
- Two-stage rotary knob with push-button function for changing settings and accessing menus 1.5 mm hex key.

The LARUS Vario Display is developed and continuously improved by Prof. Dr Klaus Schaefer, Maximilian Betz, Winfried Simon, Peter Simon and the SteFly team. You are welcome to contribute to its development and submit suggestions for improvements or report any issues.

github.com/larus-breeze

## 2.4 System Configurations

### 2.4.1 Configuration in the Single-Seater

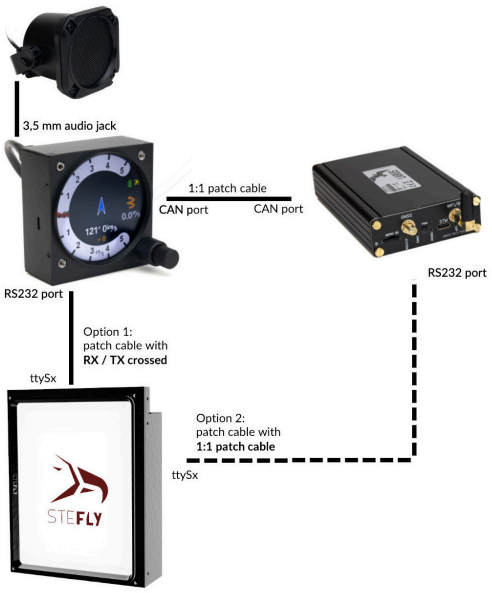



Figure 1: Wiring Diagram for Single-Seater Configuration

The navigation computer is connected to the LARUS Vario display (Option 1). This is often the simplest option. Alternatively, however, the navigation computer can also be connected to the LARUS sensor unit (Option 2).

### 2.4.2 Two-Seater Configuration

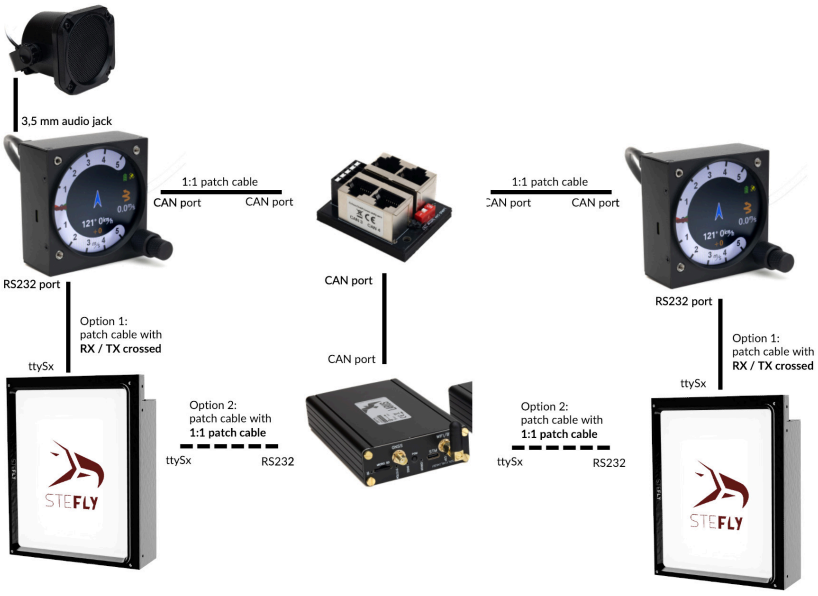



Figure 2: Wiring Diagram for Two-Seater Configuration

In a two-seater, the navigation computers are typically connected to the LARUS Vario displays. However, it is also possible to connect the navigation computers to the LARUS sensor unit. Data is exchanged between the LARUS components and distributed to the navigation computers, ensuring that no information is lost.

## 2.5 Connectors and Cabling

### 2.5.1 Connectors on the Back of the Device


Figure 3: View from the Back of the Device

The rear of the LARUS Vario display features the connectors for CAN, RS232 and the inputs/outputs. It also houses the slot for inserting the SD card, as well as the 3.5 mm jack for the audio output.

### 2.5.2 CAN and RS232 Ports

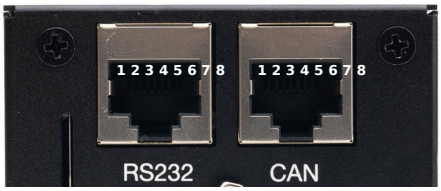



Figure 4: RJ45 Connectors in Detail

| Pin | CAN | RS232 |
|---|---|---|
| 1 | GND (internally connected) | GND (internally connected) |
| 2 | GND (internally connected) | GND (internally connected) |
| 3 | NC | RS232-1-RX |
| 4 | CAN Low | RS232-1-TX |
| 5 | CAN High | NC |
| 6 | NC | NC |
| 7 | VCC [9-28V DC] | VCC [9-28V DC] |
| 8 | VCC [9-28V DC] | VCC [9-28V DC] |

Table 1: Pin Configuration for CAN and RS232 RJ45

### 2.5.3 GPIO / D-SUB 9

Several additional switches, sensors and devices can be connected via the D-Sub connector. The following diagram shows the inside of the LARUS Vario Display connector.

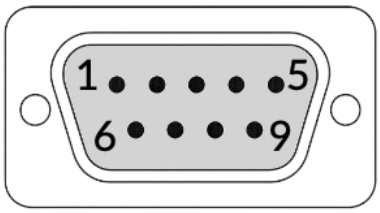



Figure 5: DSUB-9 Connector

| Pin | Name | I/O, Ground |
|---|---|---|
| 1 | GND | Ground |
| 2 | DI3 - Gear | Input |
| 3 | DI1 - Drain Ballast | Input |
| 4 | DO2 | Output |
| 5 | GND | Ground |
| 6 | DI4 - Speed Breakes | Input |
| 7 | DI2 - Speed to Fly (StF) | Input |
| 8 | GND | Ground |
| 9 | D01 - Canopy Flasher | Output |

Table 2: GPIO / D-SUB 9 Pin Assignment

To make it easier to identify the pins, these numbers are also engraved on the socket (included in the scope of delivery). Once the wiring is complete, the settings must be configured in the LARUS Vario display .

Meaning of the pin labels:

- Ground: Connected to negative
- Input: Input for a switch (open or closed)
- Output: Output is opened/closed by the display

The Input and Output pin functions must be configured accordingly; see Section 4.

### 2.5.4 Audio

An audio socket is provided for connecting a speaker with a 3.5 mm jack plug. The speaker’s impedance must be between 4 and 8 Ω (maximum output of 3 W at 4 Ω).

A single speaker must not be connected to more than one device.

### 2.5.5 SD Card

The device has an SD card slot for firmware updates.

As SD card extensions may damage the LARUS Vario Display, we accept no liability for any damage resulting from their use.

### 2.5.6 Cabling

When a serial connection (RS232) is established between the SteFly NAV and the LARUS Vario Display, the MC settings, for example, are synchronised/transferred between the devices. In addition, the LARUS Vario Display processes inputs from a Speed-to-Fly/Vario switch which is connected directly to the SteFly remote control stick. The following steps are required:

- Connecting devices with a cable:
  - The CAN port of the LARUS sensor unit must be connected to the CAN port of the LARUS Vario Display using a 1:1 patch cable (in two-seater configurations, using the cable box).
  - Devices running XCSoar can be connected via a crossed RX/TX patch cable between the RS232 port of the Vario display and the ttySx port of the SteFly NAV.
- Optionally, connect switches for detecting the release of water ballast and the landing gear warning to the corresponding DSUB-9-pin and any GND pin. For the landing gear warning, you have the option of using two separate, directly connected switches for the landing gear and the airbrakes (recommended) or a cable with both switches connected in series to the DSUB-9 connector.
- The SteFly remote control stick can be connected in two different ways:
  - Depending on the configuration: using a separate cable to DSUB-9 pin 7
  - Using the USB cable (always available)
- Please adjust the settings in XCSoar (version 7.44 or higher) / OpenSoar (7.43 or higher): If the Vario display is connected directly to the SteFly NAV, please select the corresponding ttyS port, baud rate 38400, Larus driver, and enable synchronisation (option) with the device.
- Please adjust the settings in the LARUS Vario Display for the connected optional switches.
  - Landing gear warning
  - Water ballast
  - Configuration of the speed to fly switch (if not switched automatically):
    - Input pin: To use an external switch (on the control stick, flap lever, etc.), set the Vario control to “Input pin” and select the correct setting in the StF pin configuration. (active: when open/closed)
    - NMEA for SteFly remote control stick. In addition to the settings in the Vario, you must install an event definition file in XCSoar/OpenSoar (Configuration / System / View / Language, Input / Events – enable Expert, click on Events – Download – GLB-XCI-xcremote-XCNAV.xci). Exit the XCSoar configuration and restart XCSoar.

## 2.6 CAN Termination

The LARUS Vario Display and the LARUS sensor unit are connected to each other via the CAN bus. CAN bus networks require terminating resistors at each end of the network. Therefore, all devices have a built-in switch to activate the resistor:


CAN termination switch
LARUS Vario Display

CAN termination switch
LARUS Sensor Box

CAN termination switch
CAN Splitter

Figure 6: Switches on the Devices for Terminating the CAN Bus

| Description | Front Display | Sensor Unit | CAN Splitter | Rear Display |
|---|---|---|---|---|
| Single-Seater | on | on | - | - |
| Two-Seater, Larus Sensor Unit At the Front | off | on | off | on |
| Two-Seater, Larus Rear Sensor Unit | on | on | off | off |

Table 3: CAN Wiring for Single-Seater/Two-Seater

Please note: All LARUS sensor units delivered before March 2025 do not have a CAN terminator. The CAN terminator resistors are always enabled by default.

## 2.7 External Backup

The LARUS Vario Display is usually powered via a patch cable connected between the LARUS CAN ports. LARUS must be protected by an external fuse (500 mA to max. 3 A), as is standard practice for all electrical equipment in aviation. If LARUS draws its power from another primary instrument (e.g. SteFly NAV via D-Sub connector), please ensure that the primary instrument is protected by an external fuse.

## 2.8 Installation Location

The following image shows a typical installation of the LARUS Vario display in the instrument panel of a glider.


Figure 7: Installation in the Dashboard

The display fits into a standard 57 mm cut-out and is secured with three M3 screws.

Figure 8: Fastening Elements

To install it, you will need to remove the two knobs using a 1.5 mm hex key.

## 2.9 Installation Orientation

If you intend to replace an existing device with the LARUS Vario Display, please check the desired mounting position before drilling the 7.3 mm hole for the encoder, as the display housing is slightly asymmetrical.

The display can be mounted at angles of 0°, 90°, 180° or 270°. Once the display has been mounted, its orientation may need to be adjusted in the ‘Display Rotation’ menu.

## 2.10 Initial Commissioning and Functional Test

To set up the system, please follow these steps:

1. Please check that the LARUS Vario Display is connected as shown in the diagrams in Section 2.4.
2. Switch on the LARUS.
3. Please check that the LARUS Vario Display starts up and a yellow or green satellite icon is displayed. The Vario indicators should show slight movements around the zero position.
4. You should now configure the device. All configuration options are documented in detail in the settings chapter.

## 2.11 Maintenance

The entire system contains no parts that require maintenance. To make a claim under the warranty, please contact SteFly directly.

Opening the casing of the LARUS Vario display will invalidate the warranty.

## 2.12 Firmware Update

The LARUS team is constantly improving the software and releasing firmware updates. To update the firmware, proceed as follows:

1. Switch off the device.
2. Save the new *.bin file to the SD card supplied with the device and insert it into the SD card slot on the back of the LARUS Vario Display.
3. Switch on the device.
4. When firmware is detected on the SD card, the display will remain black for approximately 3–5 seconds before the message “Installing… Do NOT power off device” appears.

5. The device will restart automatically. During the first 10 seconds, the firmware version will be displayed in the Info1 area .

The LARUS Vario Display will only install compatible firmware versions. If multiple firmware versions are stored on the card, the latest one will be installed.

If the installation fails, please repeat the process. If the installation fails again, please use a different SD card. The SD card must have a capacity of at least 4 GB (SDHC type) and be formatted with FAT32. The format must be compatible with DOS/Windows 95 (not GPT).

# 3 Operation

## 3.1 Operation


Figure 9: LARUS Vario Display

The device features a two-stage rotary knob and a push button. The following functions are assigned to the two rotary knobs:

- Turn the small/upper rotary knob: Volume control
- Turn the large/lower rotary knob: MacCready value
- Press the rotary knob briefly: Flight Menu
- Press and hold the rotary knob: Settings Menu

In the menus, the desired item can be selected using the rotary knobs. Selection is confirmed by a short press of the button. The menus contain either submenus or configuration parameters to choose from. Submenus are navigated in the same way. Once a configuration parameter has been selected, it can be modified. Changes take effect immediately. A short press of the button returns you to the menu from which you entered.

Whether you are in a menu, a submenu or the editor: you can always return directly to the main display by pressing and holding the button.

The device provides three main displays: Vario, Horizon and Device Information. You can switch between the displays by selecting the ‘Display’ option in the Flight Menu after a short press of the button. Alternatively, whilst holding down the rotary knob, you can select the desired basic display by turning it. The selected display remains active permanently. The various display modes are described in the following sections.

## 3.2 Vario Display

The central display distinguishes between circling mode and straight flight mode. The switch between these two modes is automatic. If a rotation speed of at least 1°/sec is measured for more than 10 seconds, circling mode is activated. If the rotation speed falls below this value for more than 10 seconds, the system switches back to straight flight mode.

Switching from variometer mode to mode for speed to fly does not affect the information displayed on the main screen.

### 3.2.1 Circling Mode

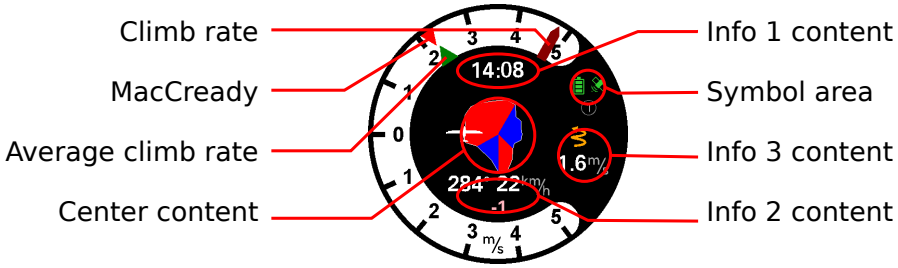



Figure 10: Display in Circling Mode

The Info 1, Info 2 and Info 3 displays, as well as the central display, depend on whether you are flying straight ahead or in circling mode. The content of these displays can be customised for both modes.

Content in circling mode:

- Current climb rate
- Average climb rate
- MacCready value
- Central display, here: thermal assistant
- Info 1 display, here: time
- Info 2 display, here: wind direction and wind speed
- Info 3 display, here: average climb rate since the start of circling
- Symbol area: The colour of the satellite symbol indicates data quality:
  - Green: Connection to the LARUS sensor unit established. Device has a GPS fix.
  - Yellow: Connection to the LARUS sensor unit established, unit has no GPS fix
  - Red: No connection to the LARUS sensor unit
- Icon area: The colour of the battery icon corresponds to the operating voltage:
  - Green: The battery voltage is sufficient.
  - Yellow: The battery voltage is in the critical range.
  - Red: The battery voltage is below the minimum value.
- Icon area: Circle: Usage Mode Club, User Profile 1 (Usage Mode Normal as a square).

### 3.2.2 Straight Flight Mode

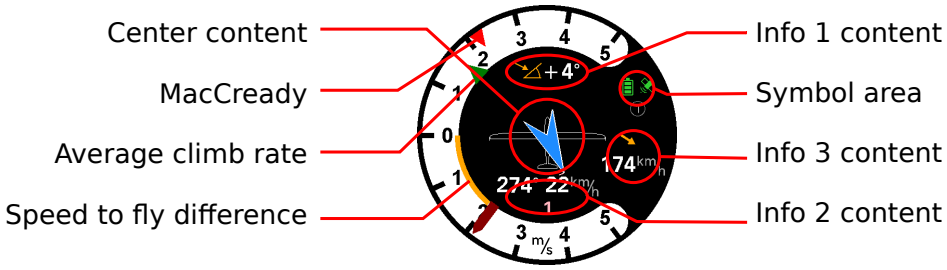



Figure 11: Display in Straight Flight Mode

Display in straight flight mode:

- Central display: shows wind direction relative to the aircraft’s longitudinal axis
- Average climb rate
- MacCready value

- Target speed indicator: The position of the bar indicates whether you are flying too fast or too slow. Positive values mean you are flying too fast; negative values mean you are flying too slow. The length of the bar indicates by how much. 1 m/s corresponds to 10 km/h.
- Symbol area: Battery symbol OK, Sat symbol OK, Usage Mode Club, User Profile 1
- Info 1 display, showing wind angle
- Info 2 display, showing wind direction and wind speed
- Info 3 display, showing speed to fly

### 3.2.3 Warnings

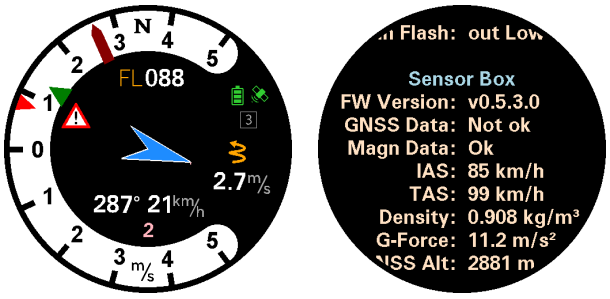



Figure 12: Displaying a Warning and Identifying the Cause

The LARUS Vario Display alerts the user if it encounters problems processing data. A red warning triangle with an exclamation mark will then appear. Although the Vario is still functioning correctly, the display quality may be reduced.

Possible causes:

- GNSS reception may be (temporarily) restricted.
- The magnetic sensor may be malfunctioning.

The cause of the fault can be identified on the ‘Device Info’ page (Section 3.4). In the example shown, GNSS reception is limited. If this warning appears frequently or continuously on the LARUS Vario display, there is an installation issue (see Appendix A).

### 3.2.4 Available Central Displays

#### 3.2.4.1 Key Displays in Circling Mode

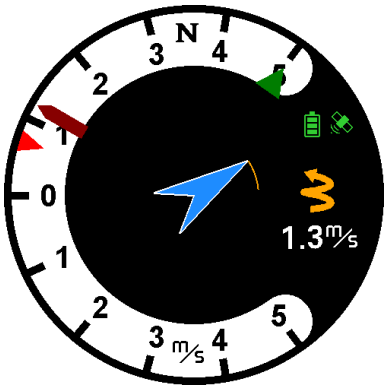



Figure 13: Wind Indicator with an Arrow and a Flag

The current wind direction is indicated by a central arrow. The size of the arrow is proportional to the wind speed. Changes in wind direction relative to the average direction are indicated by a wind vane; changes in wind speed relative to the medium-term average speed are indicated by the width of the wind vane. The direction of the arrow is relative to north, symbolised by the letter N on the scale at the top.

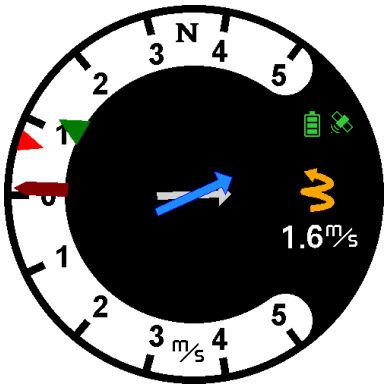



Figure 14: Wind Indicator with Two Arrows

The current wind direction and speed are indicated by the blue arrow, while information on the average wind is shown by the grey arrow in the background. The size of the arrow depends on the wind speed. The direction of the arrow is relative to north.

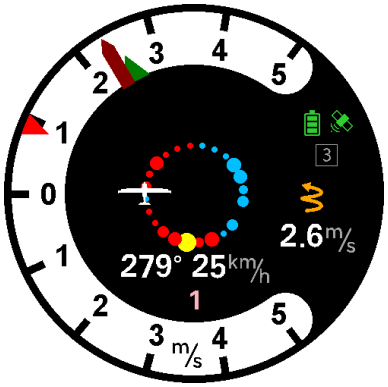



Figure 15: Centring Aid with Dots

The Thermal Assistant can help pilots centre themselves within a thermal. It clearly shows where good and less favourable climb rates can be found. This information is particularly useful, as the LARUS system displays climb rates in real time.

Meaning of the colours of the circular dots:

- Yellow: Maximum climb rate
- Black: Minimum climb rate
- Red: Climb rate is above average
- Blue: Climb rate is below average

The diameter of the dots is proportional to the climb rate. A steady updraft is optimally centred when blue and red dots occur with roughly equal frequency.

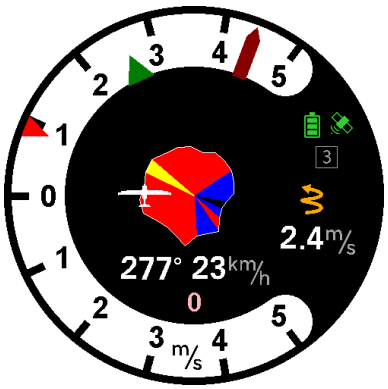



Figure 16: Centring Aid with Spider’s Web

Meaning of the colours of the circular segments:

- Yellow: Maximum climb rate
- Black: Minimum climb rate
- Red: Climb rate is above average
- Blue: Climb rate is below average

The diameter of the segment is proportional to the climb rate. A steady updraft is ideally centred when blue and red areas appear with equal frequency.

#### 3.2.4.2 Key Displays in Straight Flight Mode

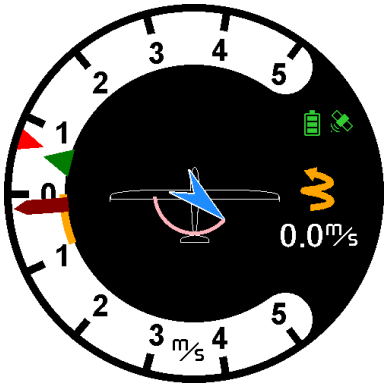



Figure 17: Wind Indicator for Straight-Ahead Flight, Featuring an Arrow and a Flag

The current wind direction is indicated by a central arrow. The size of the arrow is proportional to the wind speed. Changes in wind direction relative to the average direction are indicated by a wind vane; changes in wind speed relative to the average wind speed are indicated by the width of the wind vane. The aircraft symbol indicates that the display refers to the direction of flight.

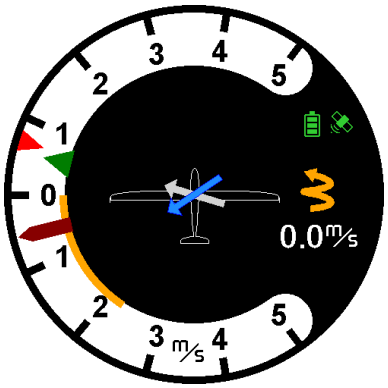



Figure 18: Wind Indicator for Straight-Ahead Flight with Two Arrows

The current wind direction and speed are indicated by the blue arrow, whilst information on the average wind is shown by the grey arrow in the background. The size of the arrows depends on the wind speed. The direction of the arrows is relative to the longitudinal axis of the glider. The glider symbol indicates that the display relates to the direction of flight.

## 3.3 Artificial Horizon

This is not an officially approved artificial horizon. Therefore, this display must not be used for flying in clouds or otherwise outside VFR conditions.

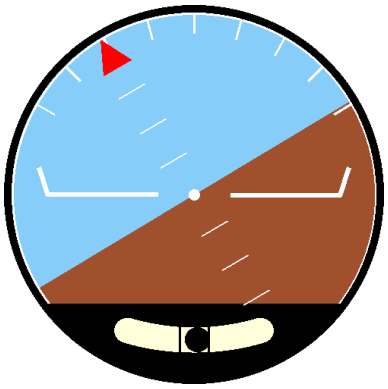


Figure 19: Artificial Horizon

The artificial horizon display shows the following information:

- The blue area represents the sky.
- The boundary with the brown area corresponds to the horizon.
- The circular scale at the top shows the glider’s current bank angle in 15° increments (here approximately 30°, red arrowhead).
- The scale parallel to the horizon indicates the climb rate or descent rate in 10° increments (here 0°).
- An inclinometer is visible in the lower section, which indicates any yaw .

The glider is currently in a clean right-hand turn with a bank angle of 30°.


Figure 20: Artificial Horizon Blocked

In some competitions, the display of the artificial horizon is prohibited. For this reason, the output of horizon information can be disabled in the LARUS sensor unit. In this case, a warning is displayed instead of the horizon.

## 3.4 Device Information

The Device Information display mode shows file information about the LARUS Vario Display and the LARUS sensor unit. This display can be useful for carrying out fault analyses or retrieving specific information. For example, it allows you to view the status of all inputs and outputs. Fault conditions affecting the LARUS sensor unit can also be identified.


Figure 21: Device Information

## 3.5 Flight Menu

The Flight Menu provides settings that are required before or during flight. The menu can be accessed by briefly pressing the control button. The headings in this section are the same as those used in the device.

### 3.5.1 Water Ballast

This is where the amount of water ballast loaded is specified. When draining the water during flight, this value can be adjusted manually or reduced automatically using a switch on the valve and the appropriate configuration.

The set value is synchronised with a connected navigation computer.

### 3.5.2 Bugs

Insects on the wings and fuselage reduce the glider’s glide performance. These changes in a glider’s performance can be approximated using this setting. Settings ranging from 0 to 50 per cent are possible. At a setting of 50 per cent, the rate of descent doubles at a given speed.

Der Algorithmus arbeit exakt identisch zu XCSoar / OpenSoar. Der eingestellte Wert wird zu einem angeschlossenen Navigationsrechner synchronisiert.

### 3.5.3 Pilot Weight

The pilot’s weight is taken into account when calculating the glider’s polar curve. For two-seaters, the combined weight of both pilots must be entered here

The value entered is synchronised with a connected navigation computer.

### 3.5.4 Display

The ‘Display’ menu option allows you to select what is shown on the device’s screen at all times. Here, you can switch between Vario, Horizon and Device Information.

### 3.5.5 User Profile

The LARUS Vario Display offers a wide range of settings to customise the display to the pilot’s needs. If several pilots fly the same glider, the User Profiles allows for easy switching between the different settings. Up to 4 different profiles can be used.

As described in the ‘Usage Mode’ section, whether 3 or 4 user profiles are available. Some settings are standardised across all four user profiles as they depend on the glider and the installation configuration. This applies, for example, to the glider’s polar curve and hardware pin configurations. This ensures that these settings are available in all profiles.

# 4 Settings

The functions listed here are used to configure the system. The headings correspond to the English text in the LARUS Vario Display menus, to make them easier to find.

## 4.1 Views

### 4.1.1 Circling, Straight

These two menu items determine what is displayed during straight-line flight and what is displayed during circling flight. The switch between circling flight and straight-line flight takes place automatically.

The following views can be selected:

- **Center Content:** Centre display
- **Info 1 Content:** Top row
- **Info 2 Content:** Bottom row
- **Info 3 Content:** Right-hand margin

Various pieces of information can be displayed in these views. The following is a list of which information can be displayed where:

**Center Content**:
- **Single Arrow** Single arrow with wind vane
- **Double Arrow** Two arrows (wind and average wind)
- **Dotted Assistant** Thermal assistant with dots
- **Spider Assistant** Thermal assistant in the form of a spider’s web

**Info 1 Content**:
- **None** Nothing
- **Avg Climb Rate** Average climb rate
- **Bank Angle** Bank angle. The symbol shows the direction of the bank angle, the numerical value the magnitude
- **Battery Voltage** Battery voltage
- **Circle Diameter** Diameter during circling
- **Circle Max-Min** Difference between maximum and minimum climb rate
- **Drift Angle** Drift angle
- **Equivalent Air Speed** Equivalent airspeed. Useful in turns and when pulling up, when the load factor increases the displayed airspeed. **Ve** then provides a stall-relevant indication independent of the bank angle. For gliders with flaps, **Ve** is also the appropriate reference for the flap setting under load
- **Flight Level** Flight level
- **G-Load** Acceleration
- **Heading** Heading
- **Indicated Air Speed** Indicated airspeed
- **Pitch Angle** Pitch
- **Slip Angle** Angle of attack
- **Speed to Fly** Speed to fly
- **True Air Speed** True airspeed
- **True Course** True heading
- **UTC Time** UTC time

**Info 2 Content**:
- **None** None
- **Avg Climb Rate** Average climb rate

- **Bank Angle** Roll angle. The symbol indicates the direction of the roll angle, the numerical value the magnitude
- **Battery Voltage** Battery voltage
- **Circle Diameter** Turn radius
- **Circle Max-Min** Difference between maximum and minimum climb rate
- **Drift Angle** Drift angle
- **Equivalent Air Speed** Equivalent airspeed. Useful in turns and when climbing, when the load factor increases the displayed airspeed. **Ve** then provides a stall-relevant reading independent of the bank angle. For gliders with flaps, **Ve** is also the appropriate reference for the flap position under load
- **Flight Level** Flight level
- **G-Load** Acceleration
- **Heading** Heading
- **Indicated Air Speed** Indicated airspeed
- **Pitch Angle** Pitch
- **Slip Angle** Angle of attack
- **Speed to Fly** Speed to fly
- **True Air Speed** True airspeed
- **True Course** True heading
- **UTC Time** UTC time
- **Wind, Avg Wind** Wind, mean wind
- **Wind and Delta** Wind and difference from mean wind

**Info 3 Content**:
- **None** None
- **CLimbing** Climb rate, averaged over the entire updraft
- **Speed to Fly** Speed to fly

### 4.1.2 Units

Various aspects of the display are shown using a unit of measurement. This section specifies which units of measurement are used:

- **Horizontal Speed** Unit of measurement for horizontal speed
- **Vertical Speed** Unit of measurement for vertical speed
- **Height** Unit of measurement for altitude

### 4.1.3 Block Horizon

In certain competitions, the use of the artificial horizon is prohibited. To ensure compliance with the regulations, the function can be deactivated until a date of your choosing. This setting can only be configured when the sensor is active and a GPS signal is available.

When you select this menu item, the date currently stored in the sensor is displayed. If this date is in the past, the artificial horizon is active. If no input is made (timeout) or the selection is confirmed, the current setting remains unchanged.

By turning the adjustment knob, a lock can be set for up to 21 days in the future. Please note that, for safety reasons, the lock date can only be moved forward in time and cannot be set back.

### 4.1.4 Energy Arrow

The energy arrow indicates the direction in which a climb rate is likely to be found. It shows the vector difference between the current wind and the average measured wind.

This function is based on the assumption that there is a flow field in the vicinity of a thermal. This influences the horizontal wind near the thermal.

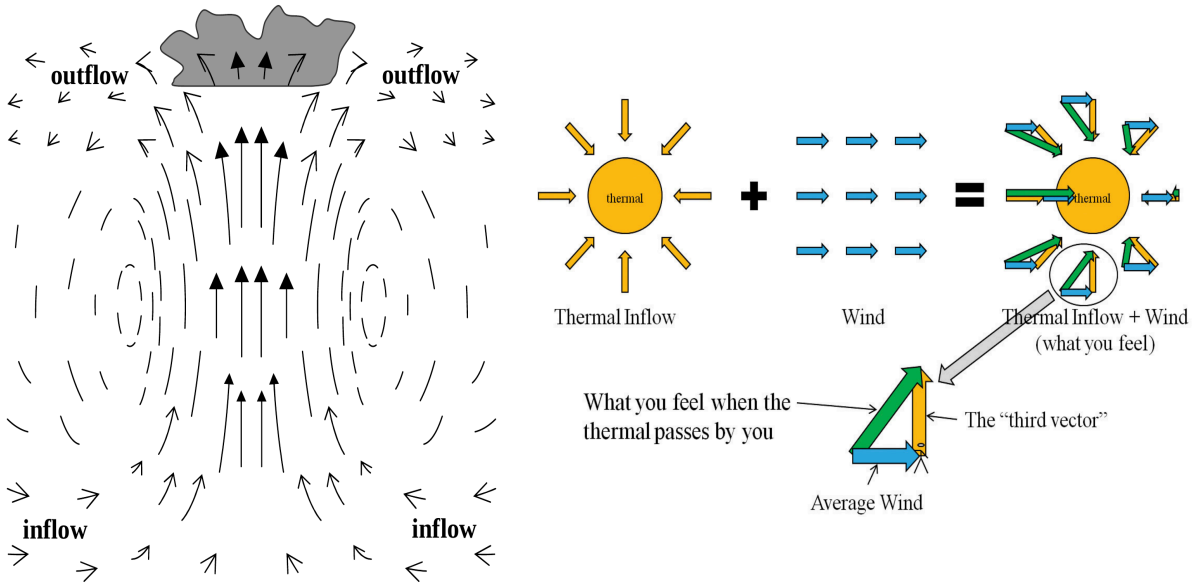



Figure 22: Flow Field of a Thermal Updraft According to Martin Dinges [1] and Its Effect on the Wind Indicator According to Joe Wurts [2]

Please note that the direction indicated depends on the altitude at which the glider is flying. At low altitude, the indicator points towards the updraft; at high altitude, however, it points in the opposite direction. At low altitude, the air flows towards the updraft; at high altitude, on the other hand, it flows away from the updraft.

However, the indicator can also be significant in other situations, such as when flying off a slope.


Figure 23: Display of the Energy Arrow in Flight

The event shown in the example was recorded just above a ridge as the glider flew past an updraft which it was later able to utilise. The display can be adjusted using a factor ranging from 0.0 to 10.0. A setting of 0.0 means the **Energy Arrow** is not displayed, whilst 10.0 means it is displayed very prominently. Start with a setting of 3.5.

Only modern variometer systems that instantly determine wind speed and direction allow for a meaningful display of the Energy Arrow. This is not possible with conventional variometers.

### 4.1.5 Display Rotation

The display can be installed at various angles (0°, 90°, 180° or 270°). The display can be adjusted to suit the installation situation

### 4.1.6 Glider Symbol

When flying straight ahead, the wind indicator is aligned with the aircraft's longitudinal axis. This can be illustrated by displaying the outline of a glider. The visual representation can be turned on or off.

## 4.2 Advanced

### 4.2.1 User Profiles

#### 4.2.1.1 Usage Mode, Code

The LARUS Vario Display's settings allow for custom configurations tailored to the pilot's needs. In club settings, it is therefore not uncommon for confusion to arise when a pilot encounters a device configured in an unfamiliar way. For this reason, the LARUS Vario Display supports two modes: Normal and Club.

In Normal mode (factory setting), all settings can be adjusted as desired. There are four user profiles (0–3) available in this mode. This allows up to four pilots to permanently use different settings.

In Club mode, two contrasting objectives are pursued. On the one hand, pilots should be allowed to use useful settings; on the other hand, standardised settings should be maintained. To achieve this, Profile 0 is locked. This profile serves as a template for the standardised settings. Profiles 1, 2 and 3 can be used as usual . However, certain configuration points, such as polar curve settings, assignment of hardware pins or access to the sensor unit. Profile 1 is reset to the default values and activated on each new flight day. The menu item "User Profile" (Section 3.5.5) also provides a function to reset the selected profile to the default values if required.

Switching between the "Usage Modes" profiles is protected by a code. The code is derived from the firmware version. For example, firmware v0.3.8.56 requires the code 3856.

#### 4.2.1.2 Config Reset

This function can be used to reset the currently selected user profile to its default values. The default values are hard-coded into the device and cannot be changed. All settings relating to the displayed data will be reset. Settings relating to the aircraft or hardware will remain unchanged.

This function is also available in the "Usage Mode" Normal mode and must not be confused with the reset to default values from Profile 0 in the "Usage Mode" Club mode.

#### 4.2.1.3 Factory Reset

This will reset the device to its factory settings. This applies to all settings for all profiles.

### 4.2.2 Vario

#### 4.2.2.1 Avg Climb Source, TC Climb Source

Two different sources are supported for calculating the average climb rate. The differences are as follows **Avg Climb Source:**

- **Frontend:** Averaging takes place whilst circling. When switching from speed to fly to vario, the current vario value is used as the starting value. When switching from vario to speed to fly, averaging is paused and the display remains constant. The time constant for averaging can be adjusted using **TC Climb Source**.

- **Sensor box:** Averaging takes place continuously. During straight-line flight, averaging is performed using a fixed time constant, which can be set in the sensor box menu. During circling, averaging takes place synchronously with the circling.

#### 4.2.2.2 Vario Upper Limit, Vario Lower Limit

The audible signal is muted between these two values.

### 4.2.3 Speed to Fly

#### 4.2.3.1 TC Circle Hyst

The hysteresis—that is, the delay when switching between Vario and the speed to fly—is set here .

#### 4.2.3.2 TC Speet to Fly

The display of the speed to fly is damped so as not to confuse the pilot with a jerky display. Here, you can specify the time constant to be used for this damping.

#### 4.2.3.3 Vario Control, StF Pin Config

The LARUS Vario Display supports various methods for switching between the Vario and speed to fly displays. The following options are available:

- **Auto:** The display switches depending on airspeed. The threshold is set at 1.1 times the airspeed required for optimal glide performance. When setting the threshold, the aircraft polar curve and the load (pilot’s weight, water ballast) are taken into account. The display does not switch back to Vario whilst circling.
- **Input Pin:** The switch is triggered by a switch or push-button (selectable) . The hardware configuration must also be set (switch/button and polarity) **StF Pin Config**.
- **NMEA:** The switch is triggered by XCSoar/OpenSoar. This setting can also be used if a joystick remote control for XCSoar/OpenSoar with a speed to fly button is used.
- **CAN:** In two-seater installations, it may be desirable for the switch between speed to fly and Vario to be triggered by the second display unit. If this second unit performs the switch automatically, for example, this ensures that both displays operate in synchronisation.

#### 4.2.3.4 Stf Upper Limit, Stf Lower Limit

You can set a speed range within which the audible signal indicating the speed to fly is muted. By default, the audio signal is deactivated within a range of +/- 10 km/h. This range can be adjusted here to suit your individual preferences.

### 4.2.4 Gear Alarm

The landing gear warning is designed to remind the pilot to extend the landing gear if he forgets to do so before landing. The landing gear warning is based on two switches that monitor the airbrakes and the landing gear. The warning is given both visually on the display and audibly. The switches can be connected either directly to the LARUS Vario display or in series via a signal line.

Direct connection of both switches to the LARUS Vario display: Both pins must be set up correctly: **Gear Pin Config**, **Airbrakes Pin Config**. **Gear Alarm Config** must then be set to **Two Pin Mode**.

Connections for the switches in series: The common wire is configured with **GearPinConfig**. **Gear Alarm Config** must then be set to **One Pin Mode**.

**Alarm Volume** allows you to adjust the volume of an alarm.

### 4.2.5 Drain Control

The switch that monitors the water drainage device is configured with **Drain Pin Config** .

A constant flow rate is assumed, which must be specified here: **Flow**.

### 4.2.6 Flash Control

The functions relating to the canopy flasher are organised as follows:

- **Flash Control:** The LARUS Vario Display is capable of controlling a canopy flasher that is activated when travelling at a speed of over 40 km/h relative to the air. Here, you must specify whether the canopy flasher is activated when the switch is open or closed.
- **Flash Test:** The canopy flasher is activated for 10 seconds. This allows you to check whether it is working correctly.

### 4.2.7 Sound

The audio output can be adjusted to suit your personal preferences using various settings.

- **Centre Frequency:** Specifies the frequency at a climb rate of 0 m/s.
- **Waveform:** Selection of the waveform for the audio output: you can choose between square, sawtooth, sine and triangle. The waveform influences the timbre through the number of harmonics it contains. Depending on personal preference and the speaker used, different waveforms may be perceived as more or less pleasant. You can get an idea of this on Ilan Flint's website [3].
- **Spreading Factor:** Specifies by how much the frequency changes as the glider climbs or descends. A value of 1.0 means that the range from −5 m/s to +5 m/s is spread over two octaves.

### 4.2.8 More Settings

This section summarises the following settings:

- **Battery Good:** Above the threshold set here, the power supply is OK (green battery icon).
- **Battery Low:** Below the voltage specified here, the battery icon is displayed in red. If the voltage lies between the two values, the battery icon is displayed in orange.

## 4.3 Polar Settings

To obtain the correct speed to fly information, you must set the correct polar curve values for your glider type. The LARUS Vario Display comes pre-loaded with more than 200 polar curves for various gliders.

If you cannot find your glider type in the list, you can select any glider polar and adjust the individual settings to match the values of your glider's polar.

### 4.3.1 Glider

Select the correct polar or the one closest to it. The name of the aircraft type cannot be changed.

Selecting an aircraft type overrides all subsequent settings, such as empty weight, maximum water ballast, etc. This cannot be undone, even if the same type is selected again later. All specific values must then be re-entered.

### 4.3.2 Empty Mass

Once you have selected the type of glider, you should adjust the empty weight (excluding the pilot's weight) of your glider so that the calculations can be carried out correctly.

### 4.3.3 Max Ballast

Make sure that the maximum water ballast matches the specifications in XCSoar/ OpenSoar, otherwise the water ballast adjustment will not work correctly.

### 4.3.4 Reference Weight

The sink rates given below for the polar curve refer to a glider with the reference mass specified here.

### 4.3.5 Polar v1, v2, v3, si1, si2, si3

The airspeeds and sink rates describe the performance of the glider being used. The polar curve is, as usual, represented by a quadratic equation. It is important to know the airspeed range within which the glider is flown between thermals, so that the speed to fly can be calculated correctly.

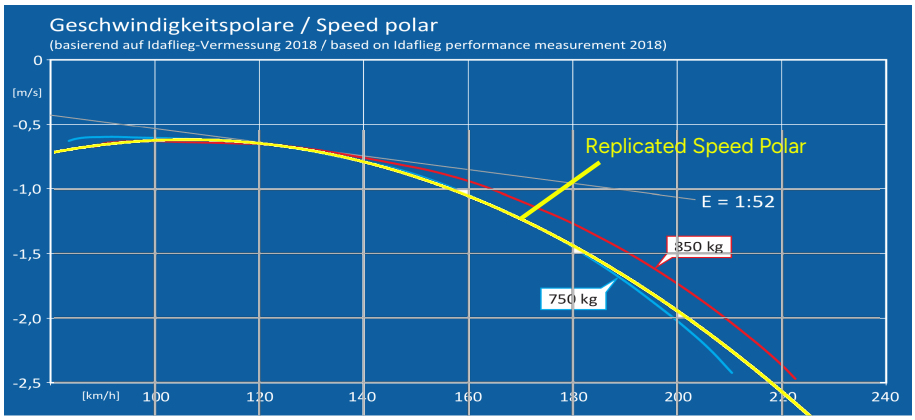



Figure 24: ASG 32 Aircraft Polar: Technical Specifications and Approximations

The polars of classic aircraft such as the ASW 20 or the LS 3 can be perfectly replicated using a quadratic approximation. With modern aircraft, however, it is important to capture the relevant speed range. Furthermore, the replication of the polars is inaccurate. The example shows the polar curve of the ASG 32 by Alexander Schleicher Flugzeugbau [4], which is very well represented in the range from 100 km/h to 180 km/h, but not beyond that. The deviation in the lower range can be ignored, but in the upper range it should be taken into account. In very good weather, the target speed indicator will set speeds that are too high.

## 4.4 Sensor Box

### 4.4.1 Calibration of the LARUS Sensor Unit

Before you take off on your first flight, the attitude sensors on the LARUS sensor unit must be calibrated precisely. The calibration process is carried out via a simple procedure, which is described below and initiated using functions on the LARUS Vario display. The calibration is carried out in two steps.

### 4.4.2 Initial Calibration on the Ground:

Assemble your glider and place it on a level surface. Once you have taken up the individual positions, wait until you can no longer feel any vibrations in the glider before proceeding with the calibration. Do not use a tail trolley to stabilise the vertical axis of your glider during the following procedures.

- **Left Wing Down:** Lower the left wing, wait briefly and call up the function
- **Right Wing Down:** Lower the right wing, wait briefly and call up the function.

- **Wings Straight:** Hold the wing horizontally, wait, then call up the function.
- **Calc Orientation:** For this step, it is important to have completed all three previous steps. The order of the steps does not matter, but they must be fully completed.

### 4.4.3 Fine-Tuning in the Air:

Precise pitch angle calibration is carried out during flight. It is recommended that you perform this step during a flight that is not disturbed by thermal gusts. Align your glider at the speed with the best glide ratio (if you have flaps, set them to this speed). Call up **Straight Flight**. You are now finished. You can check the calibration by switching to the artificial horizon display (Figure 19).

### 4.4.4 Reset Sensorbox

This function triggers a restart of the sensor box.

### 4.4.5 Init Settings

These settings for the LARUS sensor unit are intended for use by experts only and will not be described in detail here.

### 4.4.6 Test Function

This test function provided here is reserved for developers of the Larus Sensor Platform .

## A Troubleshooting

| Problem | Possible Causes | Solutions |
|---|---|---|
| The LARUS Vario display starts up, but the satellite icon is red and the Vario indicators are frozen. | Connect to the LARUS CAN port using a crossed Rx/Tx patch cable instead of a standard 1:1 patch cable. | Please replace the patch cable and use the one supplied. |
| The LARUS Vario display starts up, but the satellite icon is red and the Vario indicators are frozen. | The LARUS Vario display has been connected to the wrong port (RS232). | Please connect the CAN ports. |
| The satellite icon is constantly or frequently yellow; the altimeter and/or wind readings are implausible. | Poor GNSS reception | Ensure that the GNSS antenna is positioned facing upwards without any (metallic) shielding. |
| The Vario and/or wind readings are consistently or occasionally implausible. | The LARUS sensor unit is affected by magnetic interference. | Do not place the LARUS sensor unit near (moving) iron parts or magnets. |
| The Vario and/or wind readings are not plausible. | The mounting position of the LARUS sensor unit has not been calibrated. | Perform the calibration (Section 4.4.1). |

Table 4: Troubleshooting

# B Technical Specifications

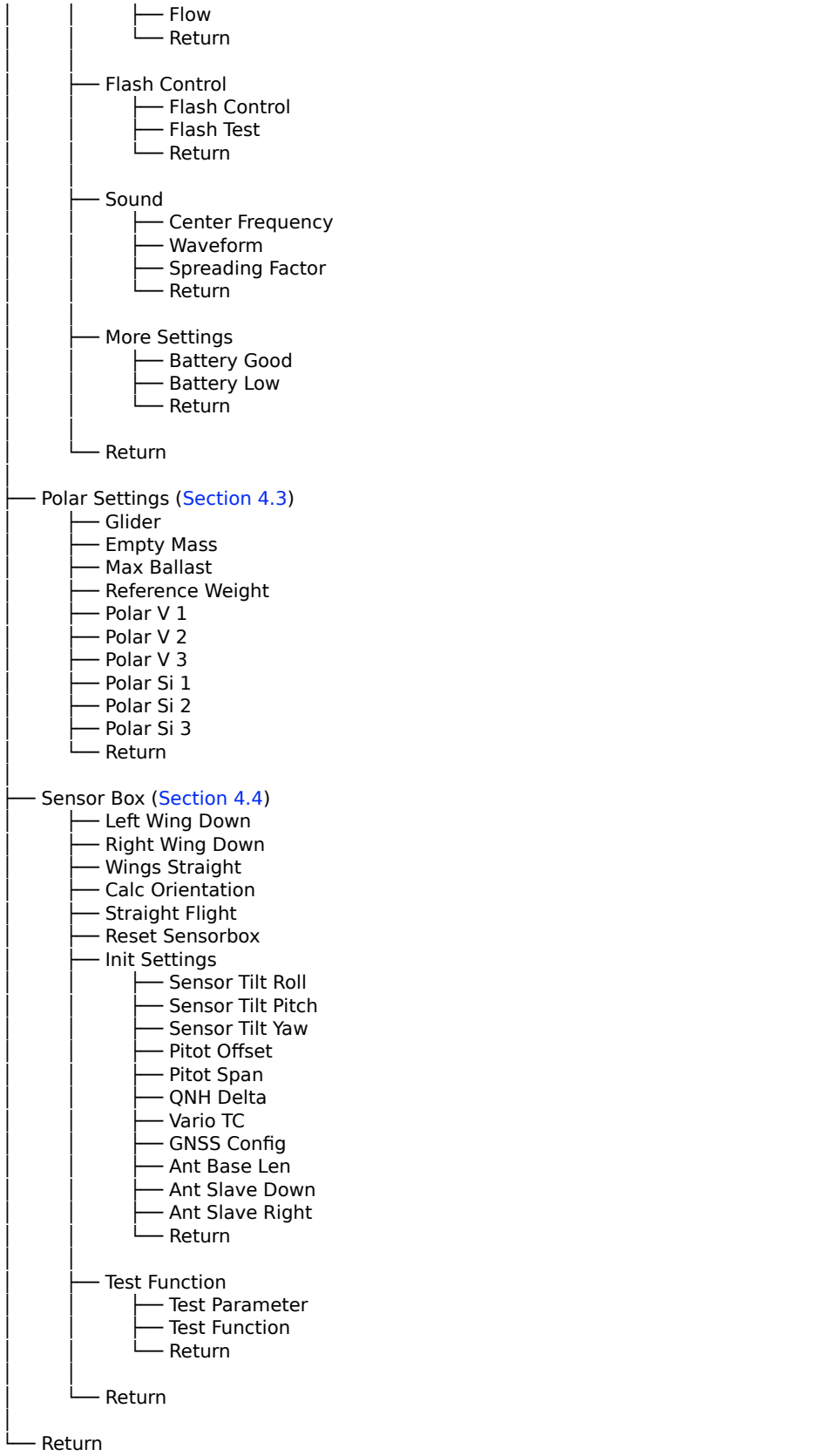
| | |
|---|---|
| Weight | 80g |
| Housing dimensions excluding the knob | 60,5 mm x 63,4 mm x 31,2 mm |
| Input voltage | 9 - 28 V DC |
| Power consumption | 80 mA |
| Interfaces | RS232-Rj45, CAN-Rj45, 4-Input, 2-Output-DSub9, Micro-SD, 3,5 mm Audio |
| NMEA interface | RS232 38400 Baud, Specification |
| CAN interface | 1 MBAud, Specification |
| Temperatures | −30°C ... 60°C |
| Humidity | 0% - 90 % |
| Housing material | Black anodised aluminium |

Table 5: Technical Specifications

# C Menus

Flight Menu (Section 3.5)
- Water Ballast
- Bugs
- Pilot Weight
- Display
- User Profile
- Return

Settings (Section 4)
- Views (Section 4.1)
  - Circling
    - Center Content
    - Info 1 Content
    - Info 2 Content
    - Info 3 Content
    - Return
  - Straight
    - Center Content
    - Info 1 Content
    - Info 2 Content
    - Info 3 Content
    - Return
  - Units
    - Horizontal Speed
    - Vertical Speed
    - Height
    - Return
  - Block Horizon
  - Energy Arrow
  - Display Rotation
  - Glider Symbol
  - Return
- Advanced (Section 4.2)
  - User Profiles
    - Usage Mode
    - Code
    - Config Reset
    - Factory Reset
    - Return
  - Vario
    - Avg Climb Source
    - TC Climb Rate
    - Vario Upper Limit
    - Vario Lower Limit
    - Return
  - Speed to Fly
    - TC Circle Hyst
    - TC Speed to Fly
    - Vario Control
    - StF Pin Config
    - StF Upper Limit
    - StF Lower Limit
    - Return
  - Gear Alarm
    - Alarm Volume
    - Gear Alarm Config
    - Gear Pin Config
    - Airbrakes Pin Config
    - Return
  - Drain Control
    - Drain Pin Config


Flow
Return
Flash Control
Flash Control
Flash Test
Return
Sound
Center Frequency
Waveform
Spreading Factor
Return
More Settings
Battery Good
Battery Low
Return
Return
Polar Settings (Section 4.3)
Glider
Empty Mass
Max Ballast
Reference Weight
Polar V 1
Polar V 2
Polar V 3
Polar Si 1
Polar Si 2
Polar Si 3
Return
Sensor Box (Section 4.4)
Left Wing Down
Right Wing Down
Wings Straight
Calc Orientation
Straight Flight
Reset Sensorbox
Init Settings
Sensor Tilt Roll
Sensor Tilt Pitch
Sensor Tilt Yaw
Pitot Offset
Pitot Span
QNH Delta
Vario TC
GNSS Config
Ant Base Len
Ant Slave Down
Ant Slave Right
Return
Test Function
Test Parameter
Test Function
Return
Return
Return

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[2] Joe Wurts, “The Third-Vector Diagram.” [Online]. Available: http://www.tailwindgliders.com/Tips.html

[3] Ilan Flint, “Online Tongenerator.” [Online]. Available: https://www.onlinemictest.com/de/tone-generator/

[4] Alexander Schleicher GmbH, “Alexander Schleicher Flugzeugbau - Die ASG 32.” [Online]. Available: https://www.alexander-schleicher.de/flugzeuge/asg-32-mi/