# Table of Contents

# 1 Preliminary Remarks

## 1.1 Important Notices

Before using any part of the system, please read and understand this manual. All information in this document is subject to change without notice. The latest version can be downloaded from www.stefly.aero.

CoTexx GmbH does not accept responsibility for damages which are the result of installation and operation of the device.

## 1.2 Limited Warranty

The LARUS Vario Display as well as its accessories are warranted to be free from defects in materials or workmanship for two years from the date of purchase. Within this period, CoTexx will, at its sole discretion, repair or replace any components that fail in normal use. Such repairs or replacement will be made at no charge to the customer for parts and labour, provided that the customer shall be responsible for any transportation cost. This warranty does not cover failures due to abuse, misuse, accident, or unauthorised alterations or repairs.

## 1.3 Conventions and Pictograph Definitions

The safety instructions in SteFly operating manuals are the result of risk evaluations and hazard analyses. In this document, the following hazard levels and information are considered:

| | |
|---|---|
|  | Pay special attention to critical notes marked with a yellow caution symbol, because non-observance may result in damage or any other critical situation. |
|  | A red caution symbol signalises that non-observance may result in injuries. |
|  | Command to perform an action or task associated with a source of danger, the disregarding of which may result in serious accidents. |
|  | A blue cloud indicates useful information or tips. |

# 2 Safety

## 2.1 Safety Precautions

**Duty to inform**
Each person involved in the installation or operation of LARUS must read and observe the safety-related parts of these operating instructions.

## 2.2 Proper Use

LARUS Vario Display visualises data which are measured and calculated by the LARUS sensor box. LARUS was designed to calculate direction and strength of thermals and wind quickly and reliably. Therefore, the sensor unit combines data from high-precision sensors and GNSS receivers in sophisticated algorithms.

LARUS Vario Display shall be installed in the instrument panel.

LARUS Gliding Sensor Unit is an additional feature to supply glider pilots with accurate information about wind, vertical air movement as well as additional attitude of the aircraft. Its use is limited to day VFR conditions. Security decisions must be made regardless of having installed LARUS.

## 2.3 Improper Use

Improper use will cause all claims for liability and guarantees to be forfeited. Improper use is deemed to be all use for purposes deviating from those mentioned above, especially:

- Using LARUS data in non-VFR conditions or during night is forbidden. LARUS is not certified. Although LARUS provides AHRS data to XCSoar you must not rely on the artificial horizon display.
- Using LARUS data during aerobatics or during flight conditions with high angle of attack (stall) or high g-forces. The algorithm was optimised for normal flight conditions.
- Operating LARUS Vario Display outside the operation conditions defined in technical data section, e.g. input voltage, temperature and humidity.

# 3 LARUS Vario Display Quick Start Manual

LARUS Vario Display may be operated out of the box. Simply perform the following actions:

1. Disassemble both rotary knobs with a 1,5 mm HEX key (scope of delivery)
2. Mount LARUS Vario Display in a 57 mm cutout of the instrument panel with 3 screws. It may be mounted in all four directions.
3. Assemble both rotary knobs
4. Connect the CAN port of LARUS Vario Display and LARUS Sensor Box with a 1:1 patch cable included in scope of delivery.
5. Power on LARUS
6. Check that the satellite symbol on the screen is yellow or green and the current heading is shown.
7. Choose or create a proper polar for your glider.
8. Your LARUS Vario Display is ready to fly!

# 4 Product Description

## 4.1 Scope of Delivery

The scope of delivery contains the following:

- LARUS Vario Display
- Mounting screws
- 1:1 standard RJ45 cable
- Micro SD card with adapter
- D-Sub-9 solder connector and housing
- 1,5 mm HEX key for mounting the rotary knobs

## 4.2 Design and Function

LARUS Vario Display shows the data measured and calculated by LARUS. LARUS is an advanced variometer with real time wind measurement capabilities. It incorporates state of the art pressure sensors, an advanced IMU and GNSS receivers to gather precise flight information data.

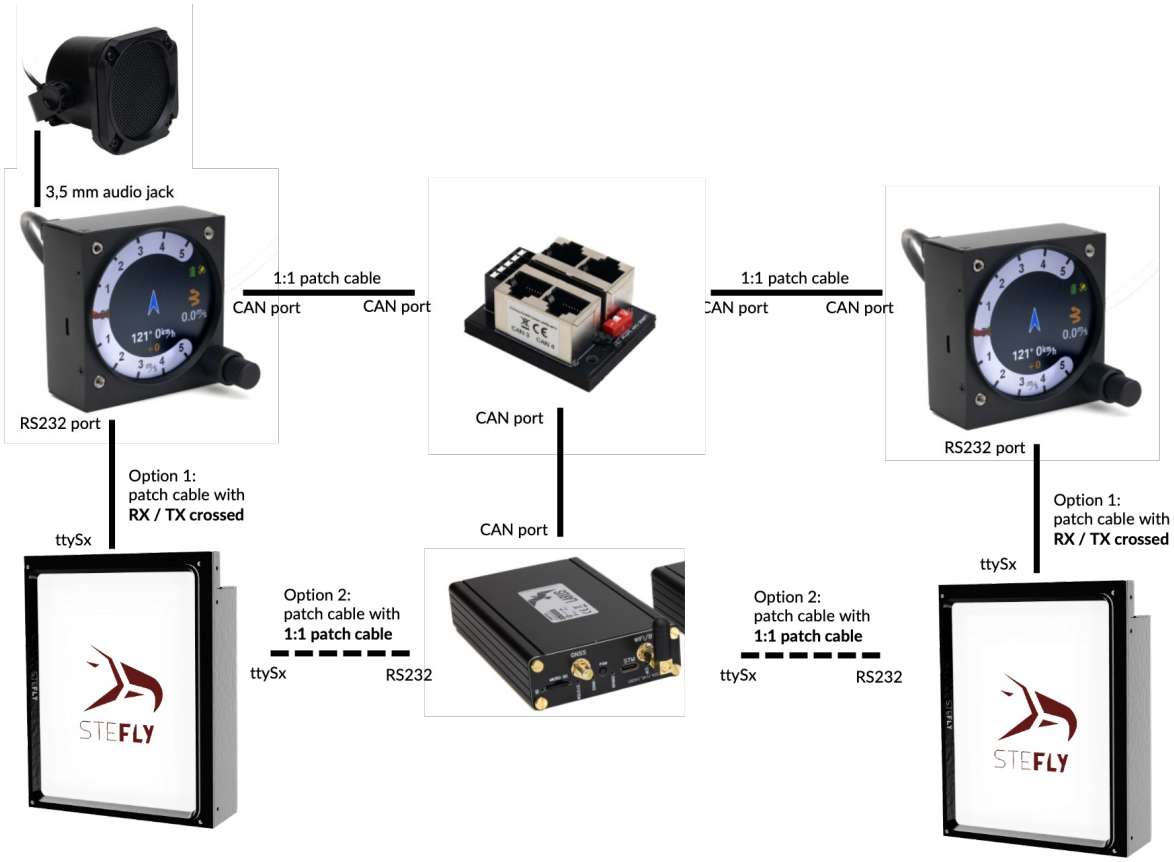
Key features of the display are:

- Round display for 57 mm standard instrument panel cutouts
- Bright and colourful screen
- Lightweight, compact design with black anodised aluminium housing
- Two rotary knobs with push-button function to change settings and enter the menus

LARUS Vario Display is designed and continuously improved by Prof. Dr. Klaus Schäfer, Maximilian Betz, Winfried Simon, Peter Simon and the SteFly team.

The system architecture of LARUS in S**ingle Seater Configuration:**

The system architecture of LARUS in **Double Seater Configuration**:




## 4.3 Connectors

### 4.3.1 Overview of the Connectors

### 4.3.2 CAN and RS232 Ports


| Pin | CAN | RS232 |
|---|---|---|
| 1 | GND (internally connected) | GND (internally connected) |
| 2 | | |
| 3 | NC | RS232_1_RX |
| 4 | CAN Low | RS232_1_TX |
| 5 | CAN High | NC |
| 6 | NC | NC |
| 7 | VCC [9-28V DC] (internally connected) | VCC [9-28V DC] (internally connected) |
| 8 | | |

If a serial connection (RS232) is established between SteFly NAV and LARUS Vario Display, the MC value settings, for example, can be synchronised / transferred between the devices. In addition, the LARUS Vario Display processes inputs from a Speed to Fly / Vario switch that is connected directly to the SteFly Remote Control Stick PCB (for necessary settings see chapter 5).

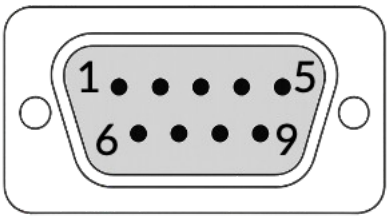
The following steps are required:

- Connect devices with cable:
  - Option 1: between Vario Display RS232 port and SteFly NAV ttySx port with **patch cable RX/TX crossed**
  - Option 2: between Vario Display RS232 port and LARUS Sensor Box with **1:1 patch cable**
- Adjust settings in XCSoar (Version 7.44 or higher) / OpenSoar (7.43 or higher):
  - If the Vario Display is connected directly to the SteFly NAV, select the corresponding ttyS port: Config -> Devices -> select a free line and enter the port, Baud rate 38400, Driver Larus, Sync. to device on

### 4.3.3 GPIO / D-SUB 9

Several other switches, sensors and devices can be connected via the d-sub connector. Please note that not all functions have been implemented at date of release of this manual.

The following sketch shows the view into the male connector of the LARUS Vario Display.




| Pin number | Pin name | I/O |
|---|---|---|
| 1 | GND | (Ground) |
| 2 | DI3 - Gear | Input |

| | | |
|---|---|---|
| 3 | DI1 – Water Ballast | Input |
| 4 | DO2 | Output |
| 5 | GND | (Ground) |
| 6 | DI4 – Speed Brakes | Input |
| 7 | DI2 – Speed to Fly | Input |
| 8 | GND | (Ground) |
| 9 | DO1 – Canopy Flasher | Output |

For easier pin identification these numbers are also moulded into the female connector (scope of delivery).

After wiring, settings must be made in the LARUS Vario Display, see chapter 5.

### 4.3.4 Audio

An audio socket is available for connecting a loudspeaker with a 3.5 mm jack plug. The internal resistance of the speaker must be between 4-8 Ω (max. output of 3 W @ 8 Ω).

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

### 4.3.5 SD-Card

The device has an SD card slot for firmware updates.

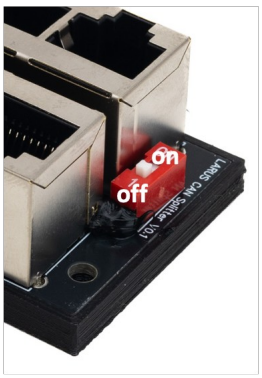
As SD card extensions can damage the LARUS Vario Display, we do not accept any liability for damage resulting from their use.

## 4.4 CAN Termination

LARUS Vario Display and LARUS Sensor Box are connected via CAN. CAN bus networks require termination resistors at each end of the network. Therefore, all units have integrated a switch to activate the resistor:


CAN termination switch
LARUS Vario Display


CAN termination switch
LARUS Sensor Box




CAN termination switch
CAN Splitter

The following table gives examples of how to set the CAN termination switches:

| Description | Display front | LARUS box | CAN Splitter | Display rear |
|---|---|---|---|---|
| Single seater | on | on | - | - |
| Double seater, LARUS box in front panel | off | on | off | on |
| Double seater, LARUS box in rear panel | on | on | off | off |

Please note: All LARUS Sensor Boxes delivered before March 2025 have no CAN termination switch. CAN termination is always on from default.

### 4.4.1 Installation

Usually, LARUS Vario Display is powered by LARUS via patch cable between the CAN ports. LARUS needs to be protected by an external fuse (500 mA to max. 3A) like it is common practice for all electric devices in aviation. If LARUS gets its energy from another main instrument (e.g. SteFly NAV via D-Sub connector) please make sure that the main instrument is protected by an external fuse.

## 4.5 Installation Location

The following picture shows a typical installation situation of LARUS Vario Display in the instrument panel of a glider.


The display fits in a standard 57 mm cutout and is fastened by 3 M3 screws.

For installation it is required to remove the two rotary knobs with a HEX 1,5mm key.

## 4.6 Installation Orientation

If you intend to replace an existing instrument with the Lars Vario Display, check the desired installation position before drilling the 7.3 mm hole for the rotary encoder due to the asymmetrical housing to the display

The display can be mounted in the orientations 0° / 90° / 180° / 270°.

After mounting the display, its orientation needs to be configured in the menu Display Rotation.

## 4.7 Initial Operation and Function Test

For initial operation please follow these steps:

1. Check that the LARUS Vario Display is connected to LARUS Sensor Box or CAN Splitter according to the drawings in chapter 4.2
2. Power on LARUS
3. Check that LARUS Vario Displays boots and a yellow or green satellite pictogram appears. The vario pointers should perform slight movements around zero position.

## 4.8 Firmware Updates

The LARUS team is continuously improving the software and releasing updates e.g. on LARUS Vario Display web page.

To update the firmware, put the new .bin-file on the SD card included in scope of delivery and insert it into the SD-card slot of LARUS Vario Display. The device will only install compatible firmware releases greater than the release installed. After powering on, the device is booting within less than a second. If a compatible firmware is detected on the SD Card, the display keeps black for about 3-5 seconds before displaying the a Firmware Upgrade is in process. Afterwards the name of the new firmware version will appear.

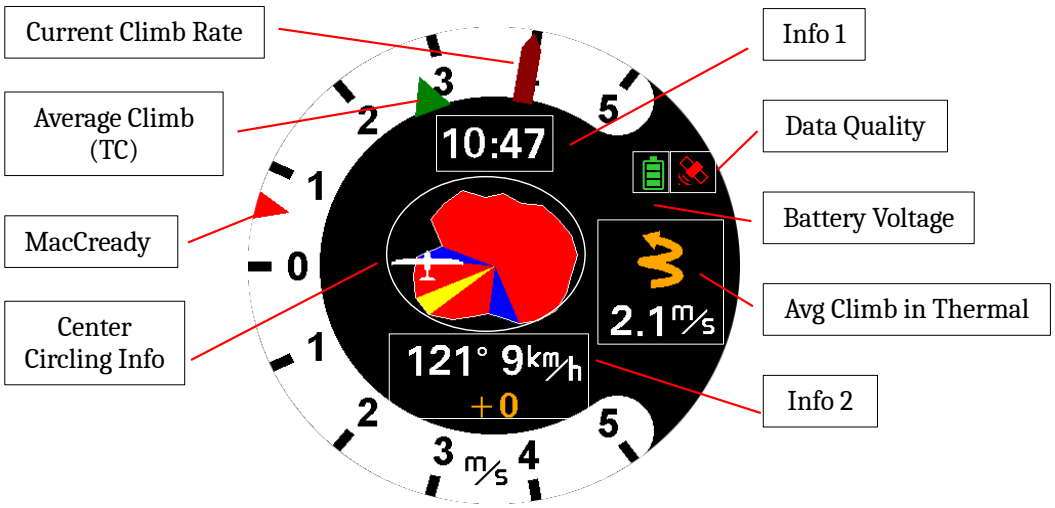
If the update is not initialised after powering on the device with an inserted SD card containing a new firmware release, please use a different SD card.
Requirements for the SD card: min. 4 GB SDHC, FAT32 format (not GPT)

# 5 Operation

## 5.1 Display

The information displayed differs depending on the flight phase:

### 5.1.1 Circling Mode




Info 1: The parameter show is defined in Info 1 Content.

Data Quality: The colour of the symbol indicates:

- Red: no connection to LARUS Sensor Unit
- Yellow: connection to LARUS Sensor Unit established, Unit has no GPS-Fix
- Green: connection to LARUS Sensor Unit established. Unit has GPS-Fix

Battery symbol: The colour of the symbol indicates:

- Green: Voltage of the battery is above Battery Good
- Yellow: Voltage of the battery is below Battery Good
- Red: Voltage of the battery is below Battery Low

Average Climb in Thermal: The average climb rate since starting circling.

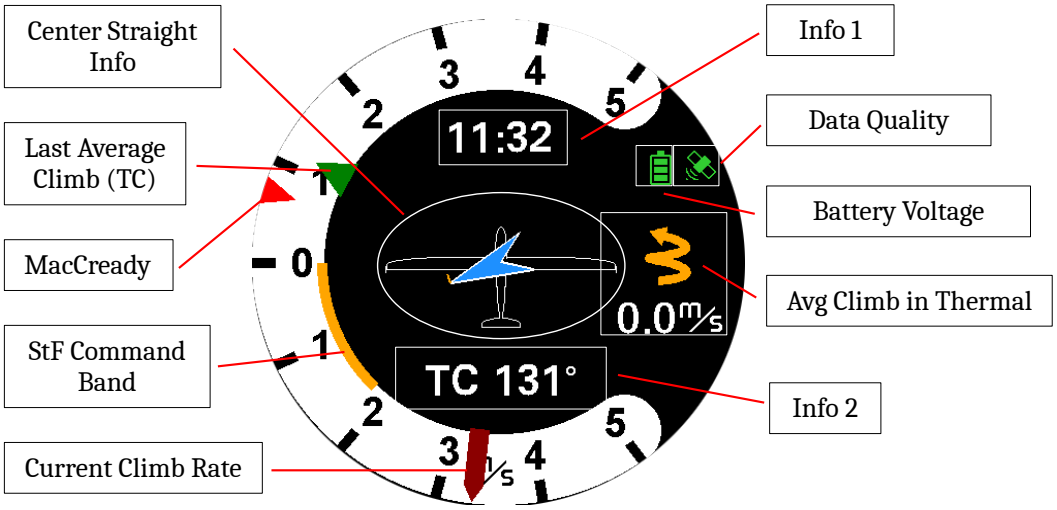
Info 2: The parameter shown is defined in Info 2 Content.

Current Climb Rate: Time Constant can be changed in Sensor Unit settings Vario TC.

Average Climb (TC): The average climb rate in the timespan defined in the TC Climb Rate.

Center Circling Info: Select one of four available graphical representations.

### 5.1.2 Straight Flight Mode




Displays that differ from Circling Mode:

Center Straight Info: Select one of two available graphical representations

StF Command Band: The position of the band shows whether you are flying too fast or too slowly. Positive values mean you are flying too fast and negative values mean you are flying too slow. The length of the tape tells you by how much. 1 m/s corresponds to 10 km/h.

Last Average Climb (TC): The green indicator for the average climb rate is showing the value for the last thermal. The value is not updated until the next switch from speed to fly to vario.

### 5.1.3 Switching the Central Display

The Central Display Graphic is switched between Straight Flight and Circling mode whenever a turn rate of at least 1°/sec is observed for more than 10 seconds. If the turn rate is less than this value for more than 10 seconds it is switch back.

### 5.1.4 Switching from Circling (Vario) to Speed to Fly

Switching the tone information from Speed to Fly to Vario is depending on your Vario Control configuration:

- Auto: below 1.1 times speed of best glide ratio: Vario mode, above: Speed To Fly mode. If in Vario mode and still circling, Vario mode keeps active even this speed limit is exceeded.
- Input Pin: To use an external switch (at the control stick, flaps lever etc), set *Vario Control* to *Input Pin* and choose the right setting in StF Pin Config (active: when open/closed)
- NMEA: Vario / Speed to Fy mode is controlled by a message received from XCSoar/OpenVario (for example when a remote stick is attached to SteFly Nav / Open Vario). **TBD**

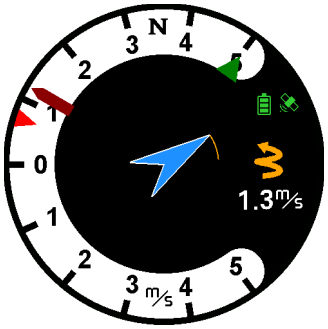
### 5.1.5 Acoustic Quiet Zone in Speed to Fly Mode.

You can define a speed range in which the acoustic Speed To Fly signal is quiet. Set the desired values in StF Upper/Lower Limit in the LARUS Vario Displays advanced settings.

## 5.2 Available Central Displays

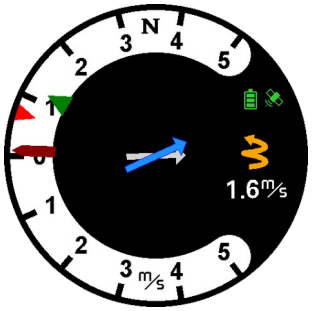
### 5.2.1 Central Displays in Circling Mode

- Single Arrow



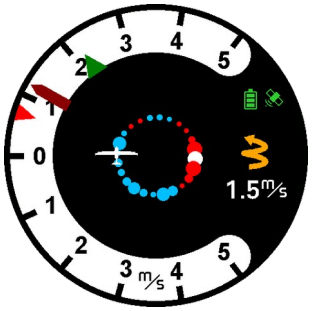

The current wind direction is represented by one central arrow. The arrow size is proporional to the wind speed. Changes of the wind direction to a mid term average direction is show by a trailing vane, changes in wind speed to the mid term average speed is represented by the vane's width.
The arrow direction is related to North.

- Double Arrow




Current wind direction and speed is represented by the blue arrow, information related to mid term wind is shown by the grey arrow in the background. Arrow sizes depend on the wind speed.
The arrow directions are related to North.

- Dotted Assistant

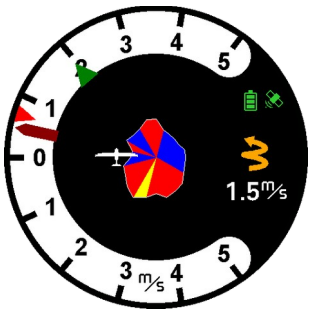



Meaning of the colours of the circle points:

- Blue: climb rate is below the average
- Red: climb rate is about the average
- White/Yellow: climb rate is above the average

  The diameter of the dots is proportional to the climb rate.

- Spider Assistant



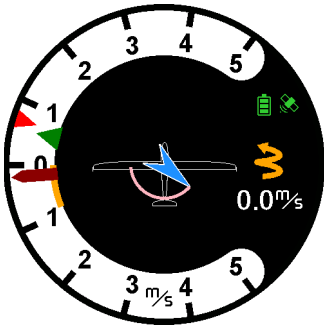

Meaning of the segment colours:

- Blue: climb rate is below the average
- Red: climb rate is about the average
- Yellow: climb rate is above the average

The diameter of the segment is proportional to the climb rate.

### 5.2.2 Central Displays in Straight Flight Mode

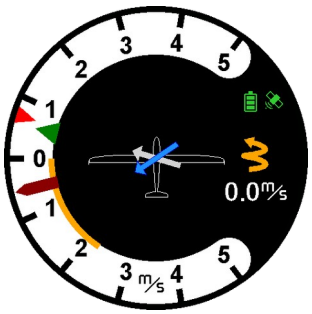
- Single Arrow




The current wind direction is represented by one central arrow. The arrow size is proporional to the wind speed. Changes of the wind direction to a mid term average direction is show by a trailing vane, changes in wind speed to the mid term average speed is represented by the vane's width.

The arrow direction is related to the airplanes longitudinal axis. It is advisable to keep the airplane symbol shown (on) in StF Mode in order to support this details.

- Double Arrow




Current wind direction and speed is represented by the blue arrow, information related to mid term wind is shown by the grey arrow in the background. Arrow sizes depend on the wind speed.

The arrow direction is related to the airplanes longitudinal axis. It is advisable to keep the airplane symbol shown in StF Mode in order to support this details.

## 5.3 Control Elements

The device has 2 rotary knobs and a push button that can be used to make various settings.

The following functions are assigned to the button and the two rotary knobs:

- **Turn the small/upper rotary knob**: Volume control
- **Turn the large/lower rotary knob: Set the MacCready value**
- **Short press on the upper rotary knob**: Menu for common settings
- L**ong press on the upper rotary knob**: Menu for configuration settings of the LARUS Vario Display, configuration and calibration of LARUS Sensor Unit.

The following two chapters show the menu structure of the LARUS Vario. Details on the submenu items are documented in the subsequent chapters..

### 5.3.1 Short Press Menu Structure

- Water Ballast
  Set the current value for the amount of water ballast. The entered value is propagated to XCSoar/OpenSoar.
- Bugs
  Set the fly correction factor in percent to adjust the polar values to the contamination situation of the wing.
- Pilot Weight
  Enter the pilots weight in kg for the area load calculation.
- Display
  Use this option to change between Vario and AHRS display.

The purpose of the LARUS Vario AHRS display is providing information for validating the LARUS Sensor Data (magnetic heading course and spatial position of the sensor/airplane). The AHRS display is not authorised as a flight instrument and must therefore not be used for this purpose.

### 5.3.2 Long Press Menu Structure

- Views
  - Info 1 Content
    - None
    - Avg Climb Rate
    - Drift Angle
    - Flight Level
    - Speed To Fly

    - True Course
    - UTC Time
  - Info 2 Content
    - same options as *Info 1 Content*
    - *Wind*, *avg Wind*
    - *Wind and Delta*
  - Center Circling
    - Single Arrow
    - Spider Assistant
    - Dotted Assistant
    - Spider Assistant
  - Center Straight
    - Single Arrow
    - Double Arrow
  - Display Rotation
    - Rotate 0/90/180/270
  - Glider Symbol
    - On / Off
- Advanced
  - User Profile
    The Vario currently supports four different user-specific settings. The settings are completely independent of each other. All settings must be repeated in each of the user profiles manually, including aircraft polar and pin configurations of the switches.
    When selecting a user profile, the device will be restarted with this profile.
    - User Profile 1
    - User Profile 2
    - User Profile 3
    - User Profile 4
    - Do not change
  - Center Frequency
    Select the centre frequency for 0 m/s (500-1000 Hz).
  - Battery Good
    Set the voltage value below which the battery symbol is shown in yellow
  - Battery Low
    Set the voltage value below which the battery symbol is shown in red
  - Flash Control
    Depending on the settings Activ: open/close: connects or opens D-SUB9 DO1 Pin to GND when the sensor measures more than 40 km/h IAS.
    - Not connected
    - Active: open
    - Active: close
  - Config Reset
    - Default Config
      Resets the settings of the current user profile to default values. The Airplane polar data is not been touched. The reset includes the configuration of the input and output pins.
    - Factory Reset
      Resets all user profiles including the airplane polar data to initial values.
    - Do not change
  - Average Climb Rate
    - Average Climb Source
      - Frontend
      - Sensorbox

        - TC Climb Rate
    - Speed to Fly
        - TC Speed To Fly
        - Vario Control
            - Auto
            - Input Pin
            - NMEA
        - StF Pin Config
            - Not configured
            - when opened
            - when closed
            - when toggled
        - StF Upper Limit
        - StF Lower Limit
    - Gear Alarm
        - Alarm Volume
        - Gear Alarm Config
            - On Pin Mode
            - Two Pin Mode
        - Gear Pin Config
            - When opened
            - When closed
            - Not connected
        - Air Brakes Pin Config
            - When opened
            - When closed
            - Not connected
    - Drain Control
        - Drain Pin Config
            - When opened
            - When closed
            - Not connected
        - Lowest Flow
            - Value in Listers/sec
        - Flow Slope
            - time based correction value
    - Return
- Polar Settings
    - Glider
    - Empty Mass
    - Max Ballast
    - Reference Weight
    - Polar V1
    - Polar V2
    - Polar V3
    - Polar Si1
    - Polar Si2
    - Polar Si3
    - Return
- Sensorbox
    - Left Wing Down
    - Right Wing Down
    - Wings Straight

- Calc Orientation
- Straight Flight
- Reset Sensorbox
- Ini Settings
  - Sensor Tilt Roll
  - Sensor Tilt Pitch
  - Sensor Tilt Yaw
  - Pitot Offset
  - Pitot Span
  - QNH Delta
  - Mag Auto Calib
  - Vario TC
  - Vario Avg TC
  - Wind TC
  - Wind Avg TC
  - GNSS Config
  - Ant Base Len
  - Ant Slave Len
  - Ant Slave Right
  - Return
- Return

- Return

# 6 Configuration

## 6.1 Glider Polar

In order to get the right Speed to Fly information you have to select or edit the right polar values for your glider. All glider polars available in XCSoar/OpenSoar have been imported into the LARUS Vario. Select the right one in Settings / Polar Settings / Glider.
After selecting the glider you should update the empty mass of your glider.

If you do not find you glider in the list, you can select any glider polar and change the single settings to the values of your gliders polar. You can currently not change the gliders name.

Every time you enter the glider list in polar settings all values you may have changed before are replaced by the selected gliders hard coded values.

## 6.2 Calibrating The Larus Senor Box

Before you start your first flight, you should calibrate the position sensor of the Larus sensor.

The individual calibration steps can be carried out using functions in the front end (minimum firmware versions required: sensor box: 0.5.1, vario: 0.3.7). Calibration is performed in two sections.

### 6.2.1 Calibration on the Ground (Roll Angle)

Assemble your glider, place it on a flat face. After taking the individual positions, wait until vibrations in the aircraft can no longer be felt before initiating the measurement.

Do not use a tail dolly in order to fix the vertical axis of your glider during the following operations.

#### 6.2.1.1 *Left Wing*

Place the left-hand tip of the wing on the surface. Invoke the function Settings / Sensorbox / Left Wing down.

#### 6.2.1.2 *Right Wing*

Place the left-hand tip of the wing on the surface. Invoke the function Settings / Sensorbox / Right Wing down.

#### 6.2.1.3 *Level Wings*

Keep the wing horizontal. Invoke the function Setting / Sensorbox / Wings straight

#### 6.2.1.4 *Calculate Roll Angle Sensor Values*

For this step it is important to carry out all three steps mentioned before. The order of the steps does not matter, but they must have been completed in full.

Invoke the function Settings / Sensorbox / Calculate Orientation

### 6.2.2 Calibration During Flight (Pitch Angle)

The pitch angle calibration is performed during flight. It is advisable to perform this step in a flight not disturbed by thermal gusts.

Level your glider out at the speed of the best glide ratio (if you have flaps, with flaps setted for this speed). Invoke Settings / Sensorbox / Straight Flight.

Now you are done. You can check the calibration by swithing to the AHRS Display.

# 7 Maintenance

The whole system has no serviceable parts.

To obtain warranty service, please SteFly directly.

Opening the housing of LARUS Vario Display will void the warranty!

# 8 Troubleshooting

| Problem | Possible Causes | Solution |
|---|---|---|
| LARUS Vario Display boots, but satellite pictogram is red and vario pointers are fixed | Connection to LARUS CAN port with Rx / Tx crossed patch cable instead of standard 1:1 patch cable | Change the patch cable and use the one supplied in scope of delivery |
| | Connection to LARUS via RS232 port | Connect the CAN ports instead |
| | | |
| | | |

# 9 Technical Data

| Size | Unit | Value |
|---|---|---|
| mass | g | 80 |
| | | |
| Housing dimensions (without knob) | mm (length x width x height) | 60,5 mm x 63,4 mm x 31,2 mm |
| input voltage | V DC | via patch cable with RJ45 connector from LARUS Sensor Box or CAN Splitter, 9 – 28 V DC |
| amperage | mA (@ 13,0 V DC) | 80 |
| interfaces | | RS232 (x1) - RJ45<br>CAN (x1) - RJ45<br>microSD<br>3,5 mm audio jack |
| operating temperature | °C | -30 to +60 |
| operating rel. humidity | % | 0 - 95 |
| material housing | | black anodised aluminium |