Level Measurement for Mobile Homes and Caravans

Level light
Level pro
Level plus

Operating instructions

Version 2.8.0

1 Contents

2 Warranty and safety

With our Level app, you can easily measure the inclination of your motorhome or caravan using a smartphone or tablet. The Level app is available in three different product variants: Level light, Level pro and Level plus

With the Level light and Level plus product variants, the inclination can be measured using an external sensor from the Chinese company WitMotion. This sensor is not part of the product. Compatibility with the sensor has been tested but cannot be guaranteed. No guarantee is given for these sensors. For information on the safe use of the sensors, please contact the sensor manufacturer.

The Level app is a technical software product that has been tested by us. Nevertheless, complex products can unfortunately have errors that were not noticed during testing. The manufacturer (Dr Dieter August Ackermann, 65plusIT) is not liable for any damage resulting from the use of the Level app.

3 The Level app

With our Level app, you can easily measure the inclination of your motorhome or caravan using a smartphone/tablet or an external sensor. The Level app is available in three different product variants: Level light, Level pro and Level plus.

3.1 Product variants

In the Light and Plus versions of the Level app, external sensors from WitMotion can be connected via Bluetooth in addition to the internal sensors of the smartphone or tablet, which then take over the inclination measurement of the vehicle and can be placed anywhere in the vehicle

The inclination of your vehicle is clearly displayed from the rear to the front and from left to right as an angle the Level app.

The Pro and Plus versions then use the displayed angles to individually calculate how many centimetres the vehicle needs to be raised at each wheel in order to be level. As this height correction for motorhomes depends on the distance between the wheels on the front axle, those on the rear axle and the centre distance, these dimensions can be specified individually in the Pro and Plus versions of the Level app. For caravans, the wheelbase of the wheels on the running axle and the distance between the axle and the support wheel are specified. The Light version does not offer this option.

The sensor for external measurement of the tilt angle is not part of the product and must be purchased separately. Compatibility with the WitMotion BWT901BLECL5.0 and WT9011DCL-BT50 sensors has been tested, but unfortunately cannot be guaranteed. For a compatibility test with your smartphone or tablet, you can use the free Level light version of this app.

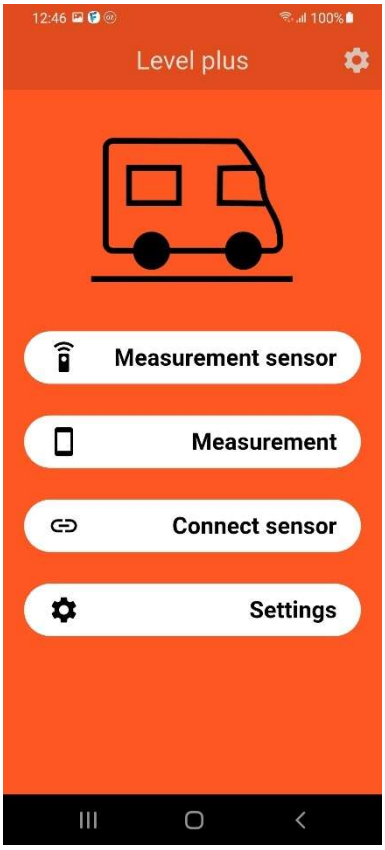
3.2 Overview of product variants

			
Product variants	**Level light**	**Level pro**	**Level plus**
Vehicle inclination in degrees front-rear	✓	✓	✓
Vehicle inclination in degrees left/right	✓	✓	✓
Vehicle inclinations also in percent	✓	✓	✓
Measurement with internal sensor	✓	✓	✓
Measurement with external WitMotion sensor	✓		✓
- WitMotion Sensor WT9011DCL	✓		✓
- WitMotion Sensor WT901BLECL	✓		✓
- WitMotion Sensor BWT901BLECL5.0	✓		✓
Individual height correction		✓	✓
Adjustable wheel spacing		✓	✓
Quick start	✓		✓
Calibration of the internal sensor (smartphone)		✓	✓
Calibration of the external sensor (WitMotion)			✓
Input calibration values for external sensor		✓	✓
Setting the measuring direction smartphone/tablet		✓	✓
Setting the measuring direction of the external sensor			✓
Language setting	✓	✓	✓
Setting of various primary colors	✓	✓	✓
Adjustment of the display inertia	✓	✓	✓
Privacy policy	✓	✓	✓
Help	✓	✓	✓
Info	✓	✓	✓

4 Description of the pages

As most of the pages and functions in the Level light, Level pro and Level plus apps are the same, they are described together here.

4.1 Main page (Home)



After starting the app, you will be taken to the main page (Home). You can only start a measurement with a sensor here if you have previously established a connection to a sensor. To do this, select "Connect sensor".

Otherwise, you can take the measurement using the sensors built into the smartphone or tablet itself.

Several setting options and information are available via the "Settings".

If you want to end a measurement but not the entire app, you should navigate to the Home page so that no more measurement data is processed by the app in the background. This is done by clicking the back icon or the home icon.

4.2 Search for and connect sensor

If you have switched on Bluetooth on your smartphone or tablet and the sensor, the sensor will be displayed here in Level light and Level plus with its internal identifier after a short time.

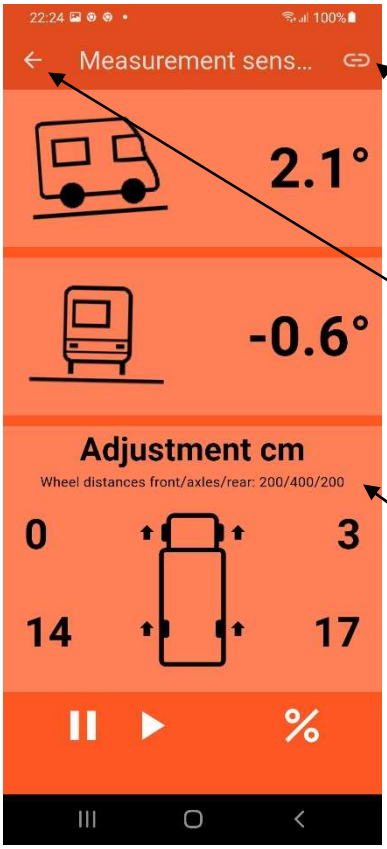
The identifiers for the sensor types are

- WT9011DCL (WT901BLE67)
- WT901BLECL (WT901BLE68)
- BWT901BLECL5.0 (WT901BLE68).

You can establish a 🔗 connection with the sensor by pressing the button. This may take a few seconds again.

If you uncheck☑ , you will be shown not only Witmotion sensors but all accessible Bluetooth devices when you call up the page again.

4.3 Measurement with Sensor or Smartphone (1)



In the upper section, the inclination of the vehicle from rear to front and the inclination from left to right is displayed in degrees and in the interval [-30° - +30°].

If the connection to the external sensor is lost, the Light and Plus versions of the sensor 🔗 can be reconnected.

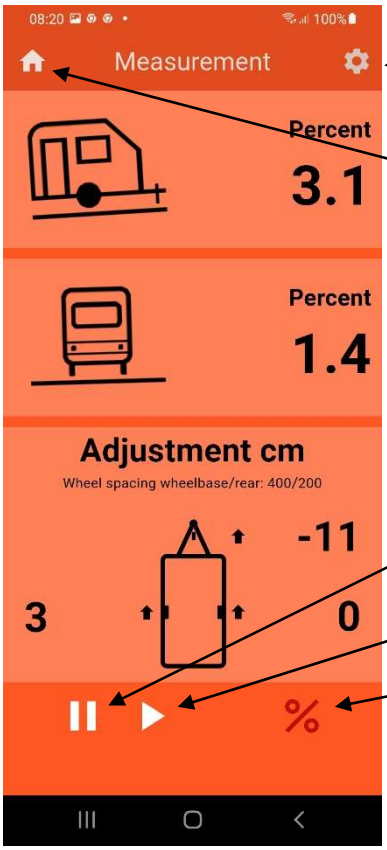
This takes you to the main and menu page after completing the measurement (recommended).

A height correction can be calculated for the individual wheels based on the individually set wheel spacing of the vehicle so that the vehicle is levelled.

The wheel distances for calculating the height correction can be found here.

Individual wheel distances can only be set in the Pro and Plus versions of the app. Demo values are used in the Light version.

4.4 Measurement with Sensor or Smartphone (2)



This takes you directly to the settings in Level pro.

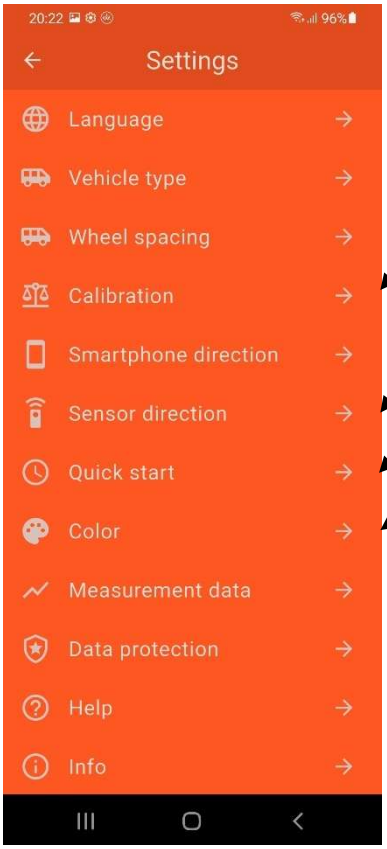
The Home button ends the measurement and returns you to the Home menu.

The Pause button stops the measurement and saves the values.

The Start button resumes the measurement.

The Percent button switches between displaying the inclination angle in 360 degrees and as a percentage during the measurement.

4.5 Settings



You can access the settings from various pages and customise how the app works for you.

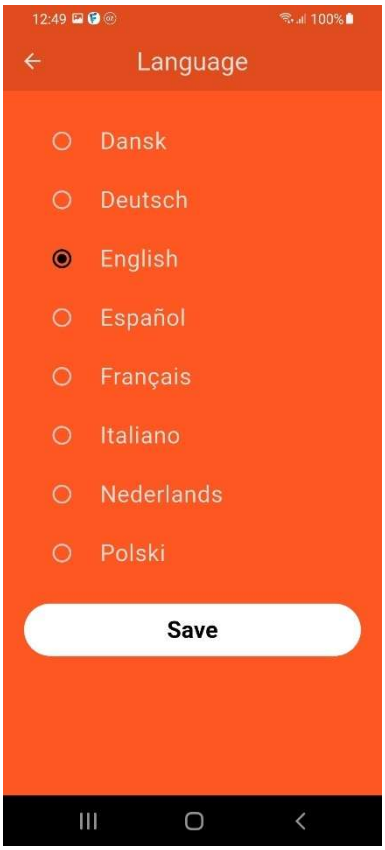
Depending on the version, calibration includes both the external sensor and the internal sensor.

Setting the measuring direction of the smartphone/tablet in the vehicle.

Setting the measuring direction of the external sensor in the vehicle.

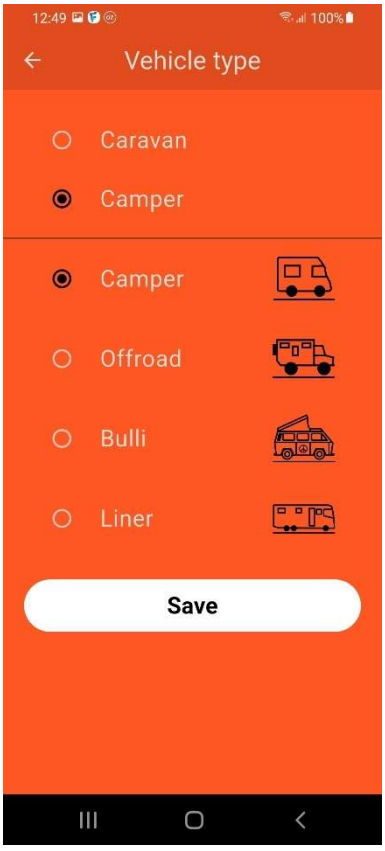
The quick start of the app and connecting the sensor is only available in the Light and Plus versions. When you start the app, you are taken directly to the page for measuring with the sensor.

4.6 Languages



You can choose between eight different languages and save the selected one.

4.7 Vehicle type

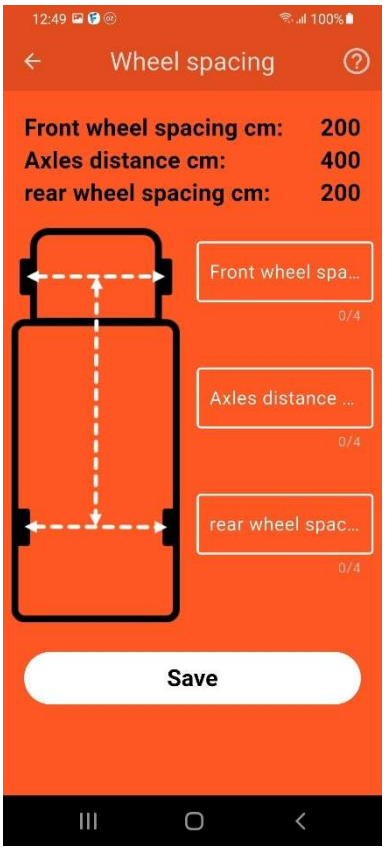


You can switch the vehicle type between motorhome and caravan in the app and save this setting.

If you have chosen a motorhome, you can then choose one of four subtypes.

For motorhomes, the height correction is calculated for four support points and for caravans for three.

4.8 Motorhome wheelbase



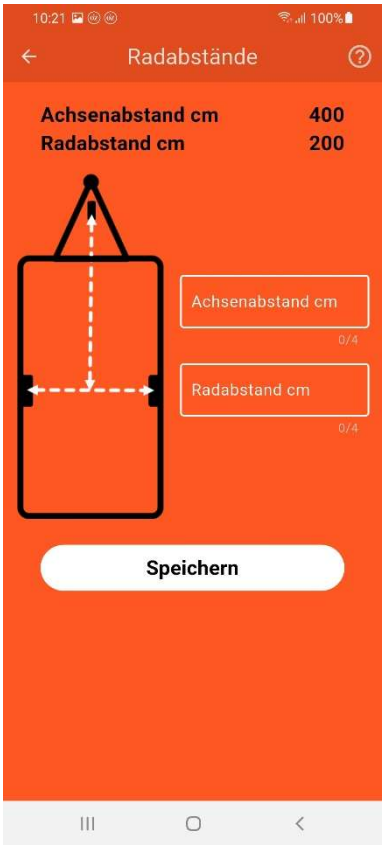
Only in the Level plus and Level pro apps can you enter and save your vehicle's wheelbase, allowing a customized height adjustment to be calculated. The measurement is taken from the center of the tire.

The currently set wheel distances are displayed in the upper area.

The wheelbases of the front axle, between the front and rear axles and the rear axle are recorded and saved in cm.

This is only possible in Level plus and Level pro. In Level light, the height correction is calculated as a demo with fixed wheel distances.

4.9 Caravan wheelbases



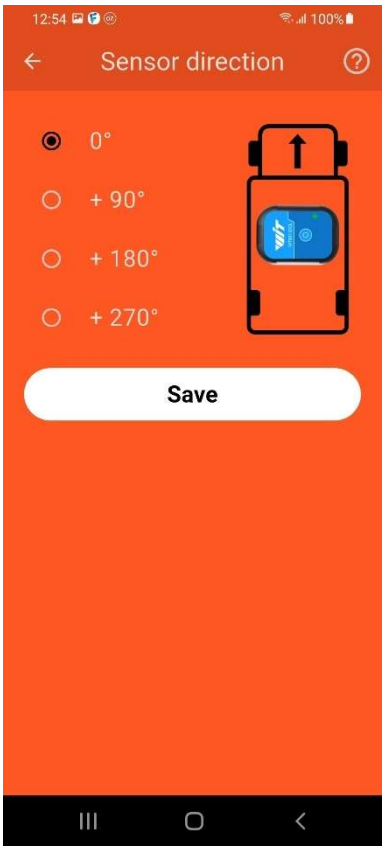
Only in the Level plus and Level pro apps can you enter and save your vehicle's wheelbase, allowing a customized height adjustment to be calculated. The measurement is taken from the center of the tire.

The currently set wheel distances are displayed in the upper area.

The wheel distances of the support wheel and the rear axle and on the rear axle are recorded and saved in cm.

This is only possible in Level plus and Level pro. In Level light, the height correction is calculated as a demo with fixed wheel distances.

4.10 Sensor direction

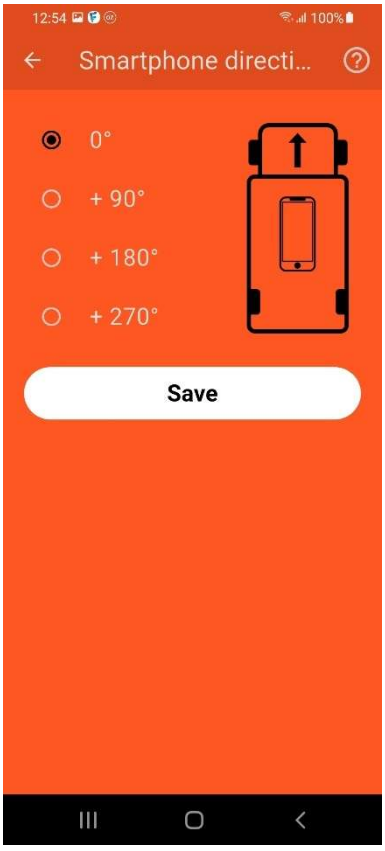


The direction of the sensor for the measurement can be set in Level plus.

By defining the sensor direction, it is possible to position the sensor even more individually in your vehicle. You have four different options for horizontal mounting, whereby the X direction of the sensor is rotated clockwise by 90° in each case.

Further information on mounting the sensor can be found in chapter 5.

4.11 Smartphone direction



The direction of the smartphone/tablet for the measurement can be set in Level plus and Level pro.

By defining the measuring direction of the smartphone/tablet, you have the option of positioning the smartphone/tablet even more individually in your vehicle for the measurement. You have four different options for horizontal measurement, whereby the X direction of the smartphone/tablet is rotated clockwise by 90° in each case.

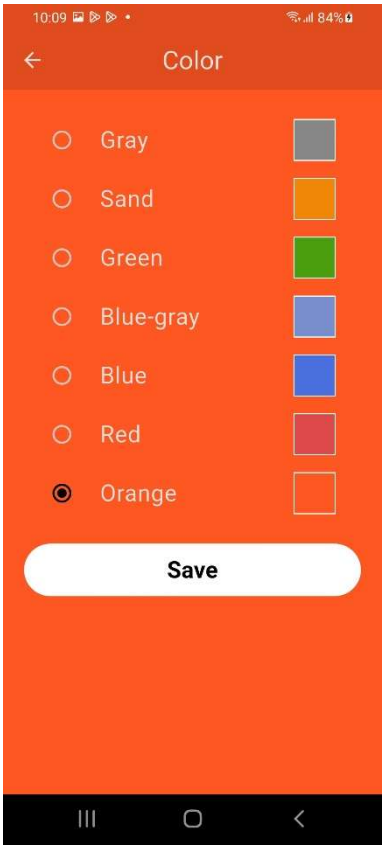
4.12 Quick start

You can set up the quick start for the connected sensor so that the page with the measurement of the sensor is displayed immediately after mounting, connecting and calibrating the sensor in the vehicle after starting the Level app.

Of course, Bluetooth must be switched on in the smartphone or tablet and the sensor must be switched on when the app is started so that the measurement page is displayed after starting the app. However, this can take a few seconds, as the sensor must first be searched for, found and then connected via Bluetooth in the background.

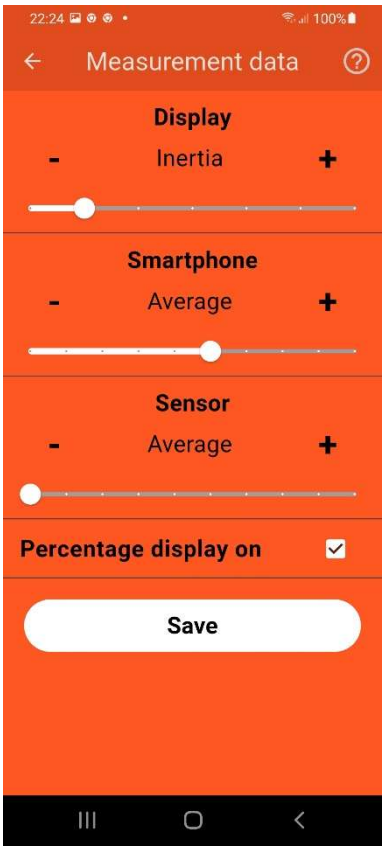
You can switch off the quick start again here with "Reset"

4.13 Colour



Here you can adjust the colour to your individual taste.

4.14 Measurement data (1)



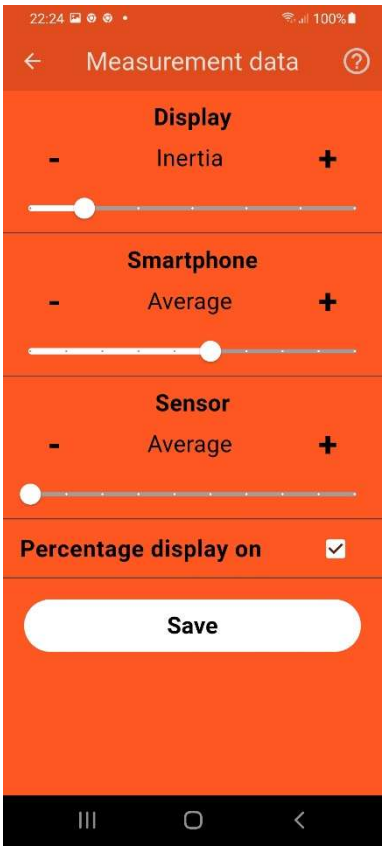
Inertia affects the display of vehicle inclination and altitude correction. You can individually increase the inertia of the measurement data on a scale of 0 to 6, where 0 means no inertia and the display is very sensitive during measurement.

Please note that a large increase in inertia also slightly increases the inaccuracy of the display.

The average allows you to smooth the measurement data from the smartphone and the sensor. The average can be set between 1 and a maximum of 10 of the most recent measurement data. Increasing the average for smartphones often leads to better display results.

When calibrating the smartphone or sensor, the average of the last 10 measurement data is used.

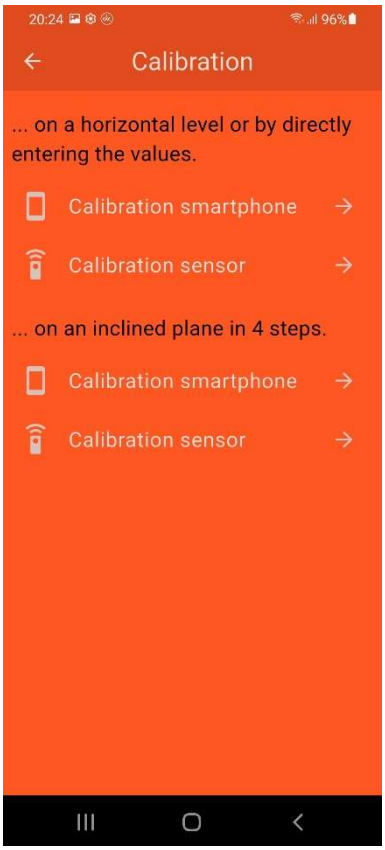
4.15 Measurement data (2)



With "Percentage Display On," you can specify whether or not you want to enable the percentage display in the "Measurement" and "Sensor Measurement" dialogs.

If this checkbox is selected, the percent button will appear in the measurement dialogs to toggle the angle display between degrees and percent.

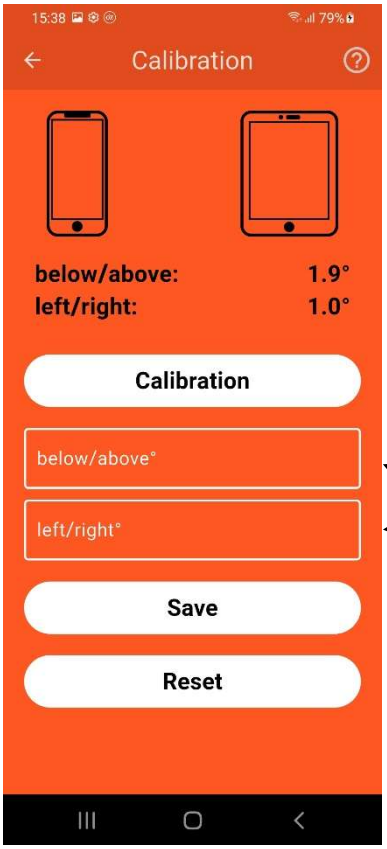
4.16 Calibration



Here you can choose whether you want to perform the calibration on a horizontal plane or enter the values manually.

If you only have an inclined, non-horizontal plane available, you can use a wizard consisting of four steps.

4.17 Calibration smartphone on a horizontal level



In Level Plus, the smartphone or tablet can be calibrated automatically and manually.

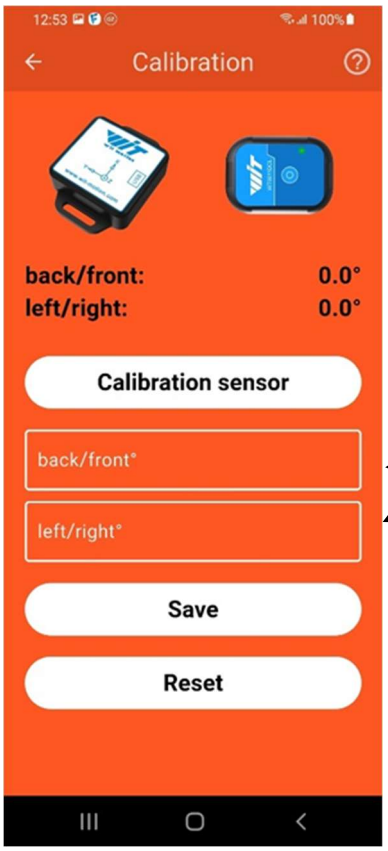
If the device is to be mounted on a non-horizontal surface in the vehicle (max. +/-30°), the device can be calibrated so that this surface is considered horizontal for the device.

The smartphone should be left still for a few seconds before calibration. Therefore, the calibration measurement only takes place after a rest period of 2 seconds. For angle measurements, the average of the last 10 measured values is always used during calibration.

The inclination values can also be entered manually here.

The inclination values are saved by clicking "Save," and the inclination values can be reset to 0 and saved by clicking "Reset."

4.18 Calibration sensor on horizontal plane



In Level Plus, the sensor can be calibrated automatically and manually. If the sensor is to be mounted on a non-horizontal plane in the vehicle (max. +/-30°), the sensor can be calibrated so that this plane is considered horizontal for the sensor.

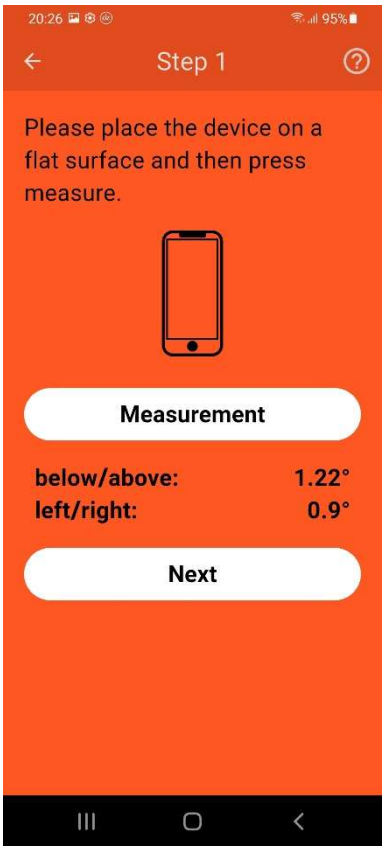
The sensor should be immobilized for a few seconds before calibration. Therefore, the calibration measurement only takes place after a rest period of 20 seconds. For angle measurements, the average of the last 10 measured values is always used during calibration.

The inclination values can also be entered manually here.

The inclination values are saved with "Save," and the inclination values can be reset to 0 and saved with "Reset."

Further information on calibrating and mounting the sensor can be found in Chapter 5.

4.19 Calibrating your smartphone on an inclined plane (Step 1)



An explanation of this process can be found in Chapter 5.5.

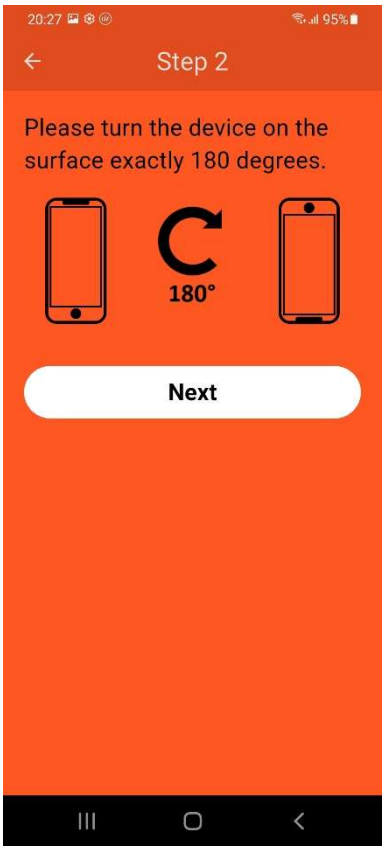
Calibrating the smartphone on an inclined (not necessarily horizontal) surface is performed in four steps.

Find any surface (e.g., a table) with an angle between -30° and +30° and place your smartphone or tablet on it.

Then press Measure. The measurement takes approximately 2 seconds. For angle measurements, the average of the last 10 measured values from the internal angle sensors is always used during calibration.

After completing the measurement, press Continue to Step 2.

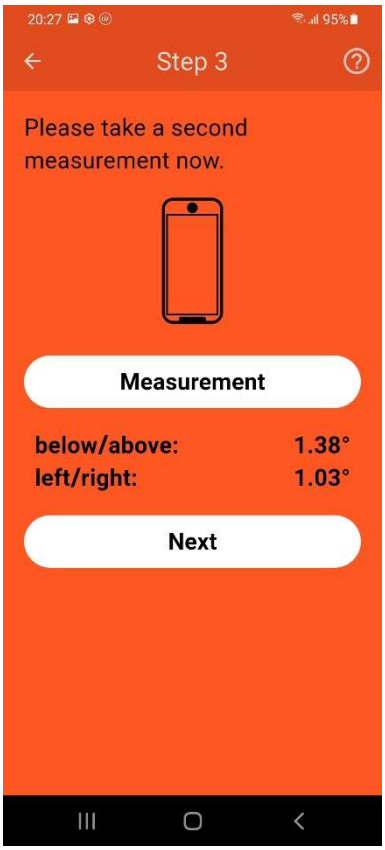
4.20 Calibrating your smartphone on an inclined plane (step 2)



Now rotate the smartphone or tablet exactly 180° on the plane.

Then click Next and go to step 3.

4.21 Calibrating your smartphone on an inclined plane (step 3)

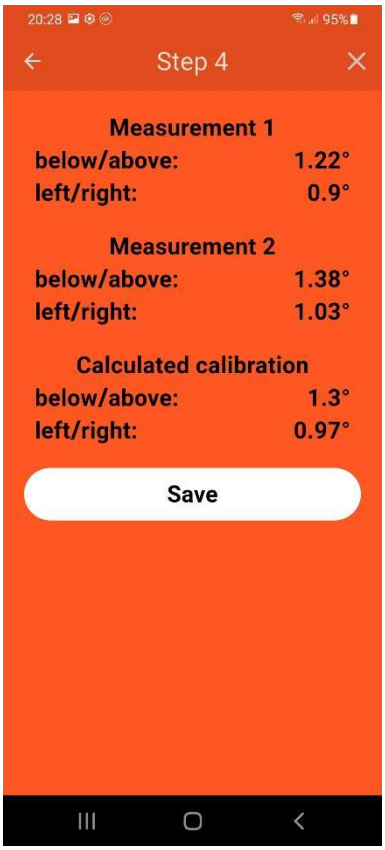


Now measure the angles in the other direction.

Note: A spirit level would show the same deviation in the other direction after rotation.

After measuring, proceed to step 4.

4.22 Calibrating your smartphone on an inclined plane (step 4)

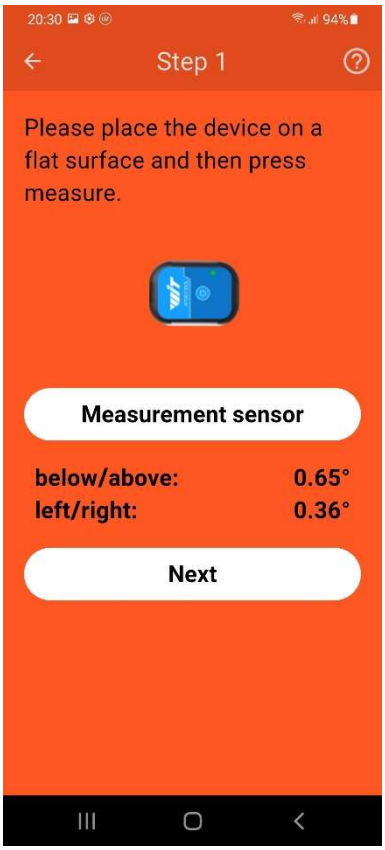


The results of Measurement 1 and Measurement 2 are displayed here. The calculated calibration is the average of Measurement 1 and Measurement 2.

Click Save to accept and save the calculated calibration.

Click X to exit the calibration process without saving the data.

4.23 Calibration sensor on an inclined plane (step 1)



An explanation of this process can be found in Chapter 5.5.

Calibrating the sensor on an inclined (not necessarily horizontal) plane is performed in four steps.

Find any plane (e.g., a table) with an angle between -30° and +30° and place the sensor on it.

Then press "Measure." The measurement takes approximately 20 seconds. The average of the last 10 measured values from the angle sensor is always used for the angle measurement during calibration.

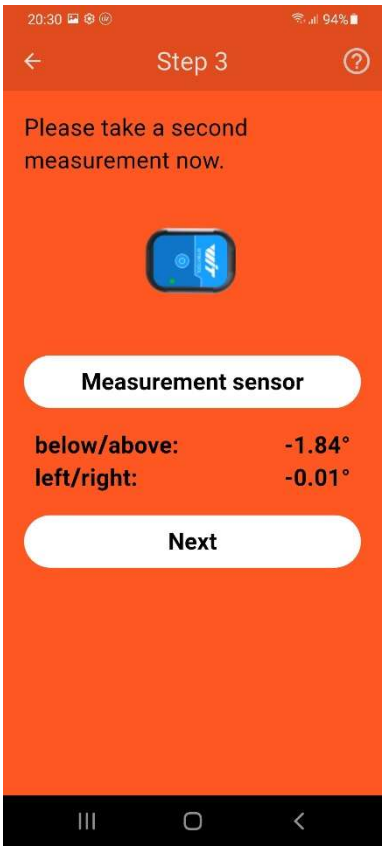
After completing the measurement, press "Continue to Step 2."

4.24 Calibration sensor on an inclined plane (step 2)

Now rotate the sensor exactly 180° on the plane.

Then press Next and go to step 3.

4.25 Calibration sensor on an inclined plane (step 3)

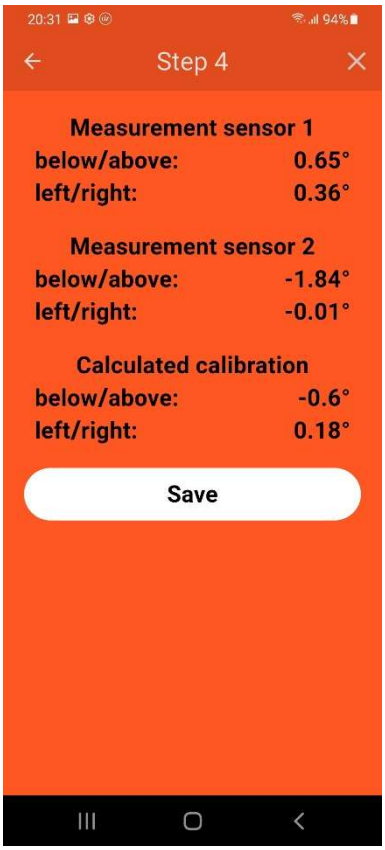


Now measure the angles in the other direction.

Note: An accurate spirit level would show the same deviation in the other direction after the rotation.

After measuring, proceed to step 4.

4.26 Calibration sensor on an inclined plane (step 4)



The results of Measurement 1 and Measurement 2 are displayed here. The calculated calibration is the average of Measurement 1 and Measurement 2.

Click Save to accept and save the calculated calibration.

Click X to exit the calibration process without saving the data.

5 Inclination measurements

The inclination measurement records the inclination of the vehicle from rear to front and from left to right and displays this in angular degrees.

The inclination is measured either with the internal sensors of the smartphone or tablet in all app versions and additionally with an external sensor from WitMotion (https://witmotion-sensor.com) in the Light and Plus versions.

WT901BLECL
BWT901BLECL5.0

WT9011DCL-BT50

5.1 Measurement with internal sensor

When measuring with the internal sensor, the smartphone or tablet must be placed with the top edge of the device facing in the direction of travel and with the screen facing upwards on the surface that is to be horizontal

If the smartphone or tablet cannot be positioned horizontally because the smartphone or tablet does not have a flat surface to rest on due to a protective cover or elevation on the device itself, or if the measurement in the vehicle should always be taken on the same non-horizontal surface, the smartphone or tablet can be calibrated in the Level pro and Level plus apps. To do this, the vehicle must first be brought into a horizontal position and then the smartphone or tablet must be calibrated at the point where the measurement is always to be taken.

The measuring direction of the smartphone or tablet can be set in the Level pro and Level plus apps.

5.2 Measurement with external WitMotion sensor

The great advantage of an external sensor is that it can be placed anywhere in the vehicle and can transmit the tilt angle to the smartphone or tablet. This means that the inclinations can be displayed on the smartphone or tablet regardless of the position of the smartphone or tablet and you can always see the current orientation of the vehicle. The smartphone or tablet can be positioned so that it is visible to the driver.

The WitMotion sensors are connected via Bluetooth. The connection is currently only available for the sensors

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- WT901BLECL
- BWT901BLECL5.0

tested. Both sensors must be purchased separately from WitMotion and are not part of the product. **Compatibility with WitMotion sensors has been tested but cannot be guaranteed.**

The sensors have a small battery that can be charged via USB-C. After switching on, a Bluetooth connection can be established. To do this, Bluetooth must be switched on in your smartphone or tablet.

5.3 Information on the sensors

Further information on the sensors can be obtained directly from the WitMotion links. The sensors can be purchased directly from the Chinese manufacturer or in the well-known online shops, whereby the prices can vary greatly. In some cases, very high shipping costs are also charged. We ordered our test sensors directly from the manufacturer.

Company links

https://witmotion-sensor.com

Links to sensors

https://witmotion-sensor.com/collections/inclinometers

WT9011DCL-BT50 https://witmotion-sensor.com/products/wt9011dcl-bluetooth5-0-compact-size-accelerometer-inclinometer-sensor?variant=44257941225669

WT901BLECL https://witmotion-sensor.com/products/wt9011dcl-bluetooth5-0-compact-size-accelerometer-inclinometer-sensor?variant=44257941258437

5.4 Positioning the external sensor

When placing the sensor in the vehicle, you should ensure that the battery can be easily charged and that you can easily operate the sensor's on/off switch. Alternatively, you can of course leave the BWT901BLECL5.0 or WT901BLECL sensor, which has an on/off switch, always switched on and connect it to a USB-C power supply in the vehicle.

In order for the sensor to measure the vehicle's inclinations correctly, it must be placed on any horizontal surface so that the X-axis points exactly in the vehicle's direction of travel and the Y-axis points exactly to the left. If you choose a surface that is not completely horizontal, you have the option of calibrating the sensor in the Level app. However, the deviation of the mounting surface or measuring surface from the horizontal surface must not exceed +30° or fall below -30°.

WT901BLECL
BWT901BLECL5.0

WT9011DCL-BT50

If it is not possible to place the sensor in your vehicle so that X points in the direction of travel and Y to the left, you can also rotate the sensor horizontally by 90°, 180° or 270°.

5.5 Sensor Calibration

There are various ways to calibrate the sensor. Should the sensor itself be calibrated directly so that it displays zero for the rear/front and left/right inclination when the surface is level, or should the sensor be calibrated relative to its measurement location in the vehicle so that it displays zero for the rear/front and left/right inclination when the vehicle is on a level surface? In this case, the sensor does not need to be placed horizontally in the vehicle.

Calibration does not change the sensor; instead, its measured values are corrected and displayed by the app.

5.5.1 Absolute calibration of the external sensor

There are two methods for absolute calibration of the external sensor, regardless of its location in the vehicle. The first method requires a horizontal and flat surface.

Method 1.1: Absolut Calibration on a Horizontal Surface

Step 1: Place the sensor on a horizontal and level surface.

Step 2: In the app, go to Settings/Sensor Calibration and click "Sensor Calibration."

Step 3: After calibration, the calibration values must be saved in the app by clicking "Save."

Method 1.2: Absolute Calibration on a Non-Horizontal Surface

It is often difficult to find a truly horizontal surface on which to calibrate the sensor. The method used here does not require a horizontal surface, but rather a flat surface that deviates within +/- 30 degrees of a horizontal surface. Two measurements are required, and the calibration correction values must be calculated from them, entered manually, and saved.

Step 1: Place the sensor on a flat surface that deviates within +/- 30 degrees of a horizontal surface.

WT901BLECL
BWT901BLECL5.0

WT9011DCL-BT50

Step 2: In the app, go to Settings/Sensor Calibration and tap "Sensor Calibration."

Step 3: Then, save the new values for back/front and left/right as back/front(1) and left/right(1), e.g., by taking a screenshot.

Step 4: Now rotate the sensor horizontally on the surface by exactly 180°.

WT901BLECL
BWT901BLECL5.0

WT9011DCL-BT50

Step 5: Now go back to Settings/Sensor Calibration in the app and tap "Sensor Calibration."

Step 6: Then, save the new values for rear/front and left/right as rear/front(2) and left/right(2), e.g., again by taking a screenshot.

Step 7: Then, manually correct the calibration values. Calculate the values for rear/front and left/right from the saved values from Step 3 and Step 6.

rear/front = (rear/front(1) + rear/front(2)) / 2

and

left/right = (left/right(1) + left/right(2)) / 2.

Step 8: Then, manually correct the calibration values. To do this, enter the calculated values for rear/front and left/right. Please note that a period must be entered instead of a comma. A negative sign can be entered by pressing the ,- key twice. Then save the values by pressing "Save."

Clear explanation of the calculation

A spirit level measures accurately and is well calibrated if the reading's deviation from the center point remains the same, even when the level is rotated 180 degrees. Anyone who wants to can also test this or calculate it themselves.

Mathematical explanation for the calculation

Tilt-back/front(surface) refers to the inclination of the surface on which the sensor rests in the X direction (back/front).

Calibration-back/front(sensor) refers to the value for the calibration of the sensor back/front.

The following applies to the measured values rear/front(1) from step 3 and rear/front(2) from step 6:

1. rear/front(1) = tilt-rear/front(area) + calibration-rear/front (sensor)

and after rotating the sensor 180 degrees

2. rear/front(2) = - tilt-rear/front(area) + calibration-rear/front (sensor)

By transforming, we obtain:

rear/front(2) = - tilt-rear/front(area) + calibration-rear/front (sensor)

⇔

tilt-rear/front(area) = calibration-rear/front (sensor) - rear/front(2)

by substituting into 1:

rear/front(1) = calibration-rear/front (sensor) - Rear/front(2) + Rear/front calibration (sensor)

⇔

Rear/front(1) + Rear/front(2) = Rear/front calibration (sensor) + Rear/front calibration (sensor)

⇔

2 * Rear/front calibration (sensor) = Rear/front(1) + Rear/front(2)

⇔

Rear/front calibration (sensor) = (Rear/front(1) + Rear/front(2)) / 2

The same applies to the left/right calibration.

5.5.2 Relative Calibration of the External Sensor

The relative calibration of the external sensor in the vehicle is performed according to the absolute calibration of the sensor. This time, only the entire vehicle is calibrated together with the sensor. After calibration, the sensor will display zero for the rear/front and left/right positions when the vehicle is on a horizontal surface. Here, too, there are two methods. For the first method, you need a horizontal surface on which the vehicle can be placed, while for the second, only a flat surface for the vehicle.

Method 2.1: Relative Calibration on a Horizontal Surface

Step 1: Drive the vehicle onto a horizontal and level surface.

Step 2: In the app, go to Settings/Sensor Calibration and select "Sensor Calibration."

Step 3: After calibration, the calibration values must be saved in the app by selecting "Save."

Method 2.2: Relative Calibration on a Non-Horizontal Surface

It is often difficult to find a truly horizontal surface on which to calibrate the vehicle and sensor. The method used here does not require a horizontal surface, but only a flat surface that, together with the sensor's measuring surface in the vehicle, must not deviate from a horizontal surface by more than +/- 30 degrees. Two measurements are required with the vehicle, and the calibration correction values must be calculated from these, entered manually, and saved.

The procedure is similar to Method 1.2 for absolute calibration, but with the entire vehicle instead of the sensor. Before rotating the vehicle horizontally by 180 degrees, you should mark the exact footprint of the vehicle's wheels.

5.6 Adjustment by Manually Specifying Calibration Values

By manually specifying calibration values, you have the option of defining any surface in the vehicle, such as a bed, stove, table, or floor, as your individual zero plane, even if you want to measure with the sensor on a different surface. To do this, the relative inclinations for rear/front and left/right between your individual zero plane and the sensor's measuring surface in the vehicle must be determined, and then the calibration values must be adjusted accordingly.

Step 1: First, perform a absolute calibration of the external sensor as described in Chapter 5.5.1. Then, note the values for rear/front and left/right as rear/front (Step 1) and left/right (Step 1), e.g., by taking a screenshot.

Step 2: Set the sensor direction in the app according to how you want to position the sensor in the vehicle.

Step 3: Measure the calibration at your personal zero plane in the vehicle, such as a stove, bed, or table, according to the set sensor direction. Then, note the new values for rear/front and left/right as zero plane-rear/front and zero plane-left/right, e.g., by taking a screenshot.

Step 4: Next, measure the sensor's measuring surface in the vehicle according to the set sensor direction, with the vehicle tilted at the same angle as in step 2. Then, note the new

values for rear/front and left/right as measuring surface-rear/front and measuring surface-left/right, e.g., by taking a screenshot.

Step 5: Calculate the relative deviations between your personal zero plane in the vehicle and the sensor's measuring surface.

Deviation rear/front = measuring surface rear/front - zero plane rear/front
Deviation left/right = measuring surface left/right - zero plane left/right

Step 6: Now manually correct the values for rear/front and left/right of the direct calibration from step 1 by the relative deviations determined from step 5.

rear/front = rear/front (step 1) + deviation rear/front
left/right = left/right (step 1) + deviation left/right

Step 7: Enter the newly calculated values for rear/front and left/right as the new calibration values and save them.

6 Technology and further information

The Level light, Level pro, and Level plus apps are developed using the Flutter development environment and the Dart programming language. This development environment and its associated APIs are constantly being improved and adapted to the latest technology. Unfortunately, this means that the current versions of the apps can no longer be used on all older Android versions (e.g., versions prior to 7.0). You can test whether the apps will run on your device using the free Level light app.

Further information is available at www.65plusit.de.