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# Calibration manual

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## Manual for Calibration and Adjustment for WiFi sensors

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# Terminology

**Device** – In case of this manual is by the device meant WiFi sensor.

**DUT (Device Under Test)** – Device to which is carried out accuracy verification (that means calibration of the device).

**Standard** – Measurement equipment (e.g. thermometer) or reference scale of certain quantity (e.g. calibration gas) used for calibration or adjustment.

**Value** – Numerically quantified representation of measured physical quantity.

**Sensing element** – Place of device or standard which is responsible to conversion of physical quantity to measured value.

**Probe** – Sensing element at the cable or at detachable connector.

# Calibration (accuracy verification)

To verify the measurement accuracy (calibration) of temperature, relative humidity, $CO_2$ concentration and barometric pressure a specific equipment for generating these quantities (calibration chamber) is required. Calibration of the instrument is performed by placing sensing element of WiFi sensor (DUT) and sensing element of standard into calibration chamber. During calibration are values of DUT and values of standard compared.

## Calibration recommendations

The calibration interval is determined by the user of the device. It is based on the manufacturer's recommendations and according to the requirements of the application in which is the WiFi sensor used. The manufacturer's recommended calibration intervals are stated in the User Manual. In some specific applications, calibration must be performed by an independent accredited laboratory.

## General calibration conditions

- The equipment of the workplace must be able to assess the measuring accuracy of the WiFi sensor by its parameters. As a rule, the instruments are checked for accuracy specified by the manufacturer, however the user of the WiFi sensor can determine his own parameters. For each measuring point it is necessary to calculate the so-called extended measurement uncertainty, which includes the properties of the whole measuring chain (accuracy of standards, inhomogeneity of the field in the calibration chamber, resolution of instruments, etc.). This uncertainty must be better than the required DUT accuracy in order to evaluate the measurement accuracy of the DUT. The determination of uncertainties is performed according to document EA-4/02. For each measuring point, the standard value, the measured value of the DUT and the measurement uncertainty shall be reported. The evaluation can be added.
- Used standards must be metrologically traceable to the valid higher standards. A reference gas of known concentration (for $CO_2$) or a calibration solution (for relative humidity) may to be used as the standard. There is an indicative rule which says that standard should have at least three times better accuracy than DUT.
- When calibrating physical quantities, the sensing element of standard and sensing element of DUT in calibration chamber should be placed closest as possible. The distribution of temperature and relative humidity in the calibration chamber may not be completely homogeneous. Due to improper placement of sensing elements may be subject to a large systematic error. If the calibration is carried out at different temperature than ambient, it is necessary to ensure, that the values are not affected by the heat transfer

between the calibration chamber and the environment - especially over the cables of standard or DUT.

- When calibrating the temperature and/or the relative humidity, the airflow in the chamber must be about 0.5 to 1 m/s. It is strongly recommended to insert only the probe to the chamber without body of DUT. Because unwanted heating caused by DUT can affect the measured values. This can be difficult for DUT with compact short probes. In this case of DigiS/E probe can be connected by using the "Extension cable SDP001". However, if despite everything you must insert the entire WiFi sensor into the chamber, then connect the power supply a short time before reading values.
- When calibrating the $CO_2$ concentration, the recommended calibration gas flow rate is 1 l/min. If the entire DUT is inserted into the chamber when calibrating the $CO_2$ concentration, we recommend unscrewing the bottom lid of WiFi sensor cover to allow better airflow to speed up its response.
- Calibration shall be carried out at points that sufficiently cover the measurement range in which the WiFi sensor is used at application. Temperature, relative humidity, $CO_2$ concentration and pressure generated by the calibration chamber must not exceed the measuring range of the WiFi sensor.
- The time for starting and stabilizing the calibration chamber must be known in advance or can be reliably ascertained during calibration. This can be done by monitoring the values of the standard. Stability of the calibration chamber means the condition when the calibrated quantity does not change anymore and the air circulating in the chamber has the same temperature as the walls of the chamber (there must be no influence on the DUT or standard by heat radiation or moisture condensation). Temperature fluctuations within a few tenths of °C can cause the relative humidity measurement error that can be in many percent.
- Some external temperature probes can also be calibrated in liquid if the probe design allows such calibration. When probe is calibrated in liquid, it is necessary to prevent liquid ingress into probe. The critical point is the cable outlet from the probe body.
- Some Comet external humidity probes can be calibrated using the MD046 "Vessel for adjustment and calibration of humidity" and the calibration solutions HM023 and HM024. During calibration, the Vessel must be well sealed, and the probe and the vessel well settled at a constant temperature. It is advisable to place the vessel on a temperature non-conductive pad. After stabilization (at least 2 hours) read the measured humidity from the DUT and use the value from the solution standard calibration certificate.

# Preparing the WiFi sensor for calibration

- Perform an optical check for mechanical or other visible damage. In case of damage, hand over the device for repair.
- Check if the device is not reporting a weak battery for real-time clock backup. If so, follow recommendation in User manual.
- The measured values can be read directly from the LCD display of the WiFi sensor or using one of the supported communication protocols (e.g. web or Modbus).

# Calibration procedure

- Place the prepared DUT or its probe into the calibration chamber. Place the probe of the measuring standard near the sensing element of the DUT. If you read the measured values directly from the LCD display of the device, place the DUT so that it is LCD display visible.
- Close the calibration chamber, start it, and set the desired calibration point value.
- Wait for the stabilization of device. The stabilization time can be counted from the moment when the controlled quantity has stabilized in the calibration chamber. This time should be at least three times the response time t90 specified in the User manual for the calibrated quantity.
- After this time, read the measured value of the standard and the value from the calibrated DUT.
- Set the chamber to generate another value for next point and repeat the above procedure for all required calibration points.
- When calibration is finished, remove the DUT from the chamber and evaluate the measurement.
- The instrument's accuracy for each calibration point is specified in its User manual. When evaluating the measured values, it is necessary to consider the extended uncertainty of measurement (may vary for each calibration point).
- If high deviations are found (temperature measurement error greater than 1 °C, relative humidity greater than +/-5 %RH, pressure greater than 5 hPa or $CO_2$ greater than 10 % of the measuring range), switch off the device and contact the distributor or service department**.** In case of minor deviation, you can carry out device Adjustment (see chapter *Adjustment*).

# Adjustment

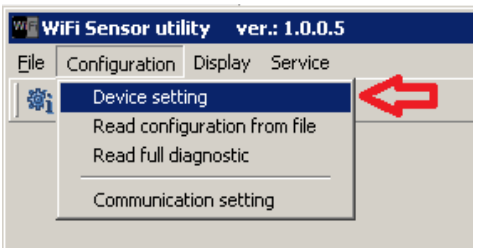
Adjustment means action resulting in setting WiFi sensor to the state, when its actual measurement accuracy is identical or better than measurement accuracy specified in instruction manual. Adjustment is possible only for measured values (temperature, relative humidity, $CO_2$ concentration or pressure). For this operation, as well as for the calibration, a special equipment for constant temperature, relative humidity, $CO_2$ concentration or pressure generation is needed. Device adjustment is performed by placing the adjusted device to the calibration chamber and by consequent assignment of measured values to standard reading by means of the WifiSensorUtility software.

## WiFi sensor Adjustment Conditions

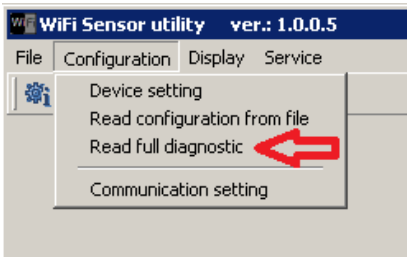
- Any unqualified entry into the instrument adjustment mode to may rewrite the existing calibration constants. It can cause that the instrument will be unable to measure!
- Follow recommendation and conditions for calibration during the device adjustment.
- Adjustment of the measured values should be done in two point. These points should be as far apart as possible within the required measuring range. In some cases, the calibration can be made at one point.
- When adjusting the relative humidity, it is not recommended to use an upper adjustment point higher than 90 %RH. Recommended values for relative humidity adjustment are (10 – 20) %RH and (70 – 80) %RH.
- After the adjustment, it is always necessary to verify the correct measurement accuracy of the newly adjusted device (see the *Calibration procedure*).

# Adjustment Procedure

- For adjustment of WiFi sensors is **WifiSensorUtility** used. This software can be obtained from technical support on the request.
- Install WifiSensorUtility software at computer with Windows operating system. Administrator rights for installation of software are required.
- Start the WifiSensorUtility and connect WiFi sensor using USB-C cable to computer. Check the device settings:




- Check the channels setting whether is correct. Make sure that proper time is set as well.
- Before adjustment it is strongly recommended to back up the current sensor settings to file for possible restoring:




  Save the backup file! Backup file allows you to return the settings to the previous state, including calibration. Restoring can be done using *Service-Restore configuration from file* menu item.

  *Note: Calibration of Digi probes cannot be restored in this way (see below).*

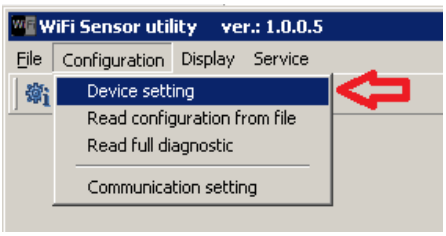
- Be aware that administrator password for device is required in case of device security is enabled.
- When adjusting the relative humidity, it is recommended that the device and the standard are stabilized at room humidity for at least 30 min. **Follow the recommendation for calibration** regarding the placement of devices in the calibration chamber. Avoid incorrect measurements due to heating of the sensing element.

- For device with external temperature probes, it is advisable to place only an external probe into the calibration chamber generating the relevant quantity. If the calibration is carried out at different temperature than ambient temperature, a sufficient part of the cable with the probe must be inserted into calibration chamber. This can prevent heat transfer between the chamber and the environment through the cable.
- The measurement standard (temperature, relative humidity, pressure, and $CO_2$) is also placed in the calibration chamber. **During adjustment proceed in the same way as described above for calibration**.
- Close and run the calibration chamber. Set to calibration chamber to a **first adjustment point** value.
- **Wait for the device to stabilisation.** The device stabilization time can be counted from the moment when the controlled quantity has stabilized in the calibration chamber. When device is stabilised note value of the standard and value of device.
- Repeat this procedure for the **second adjustment point** (if necessary).
- **Save new adjustment constants** to the instrument (see *below*).
- After the adjustment procedure it is necessary to make device calibration procedure.

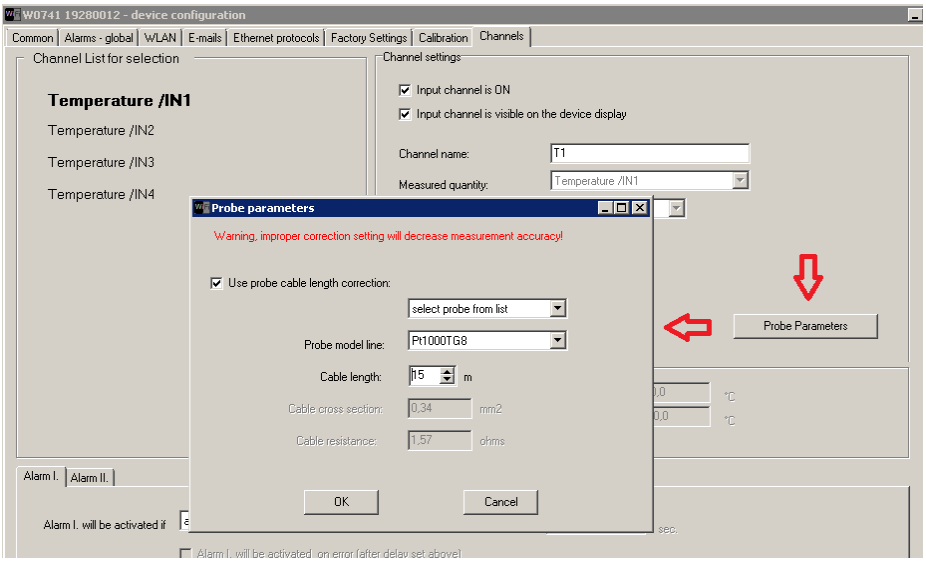
# Saving of the new Adjustment

## Temperature Adjustment (W0710, W0711, W0741, W3745)

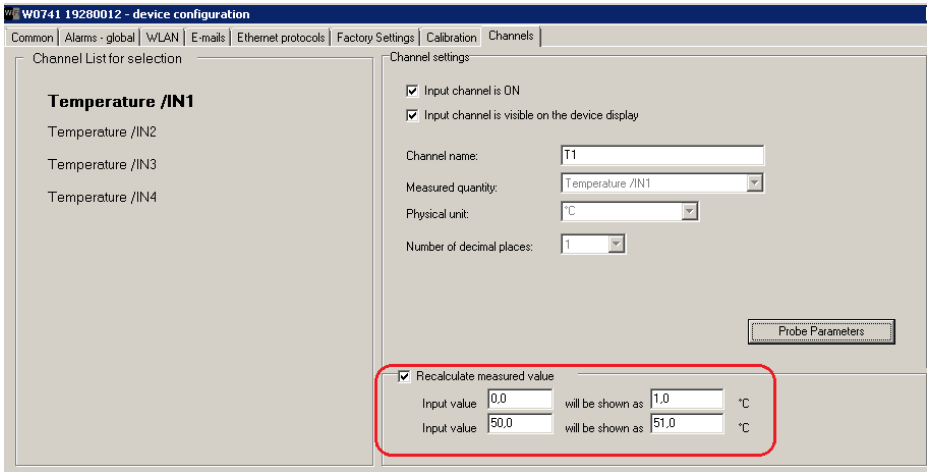
- Input adjustment can be performed using *Service – Device adjustment* menu item, however, **we do not recommend this way.** The device inputs for Pt1000 RTD sensors are very stable. From this reason is not recommended to change calibration constants if the probe does not measure accurately.
- There are two ways to improve measurement accuracy. It can be set **correction to cable length** or **user calibration** can be used.
- At first step enter *Device settings* and show *Channels* bookmark:




- In case of probes with longer cables are used, it should be set **correction to cable length** as shown at image below:



- If correction to cable length is correct, it can be set **user calibration**:

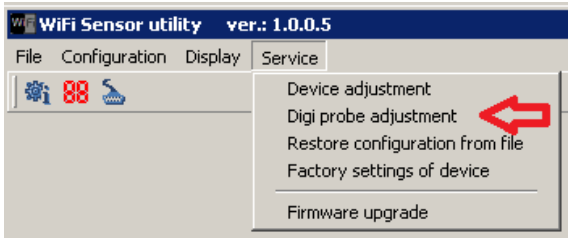



*If the WiFi sensor measured 25 °C before this setting, then 26 °C will measure after it.*

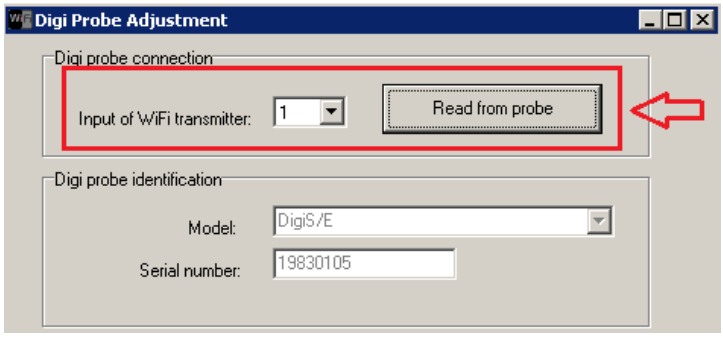
## Temperature/Humidity Adjustment (W3710, W3711, W4710, W3721, W3745, W7710)

- **Important note**: The calibration constants are not stored in the instrument itself, but inside the probe. Calibration constants at Digi probe cannot be restored by backup file downloaded from device. Digi probes can be restored into factory defaults only.

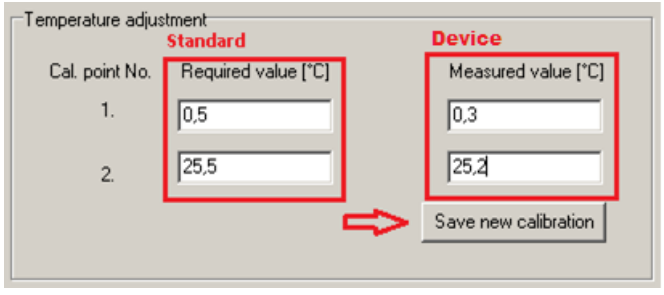
- select *Service – Digi probe adjustment* menu item:




- select Input and click *Read from probe* button:

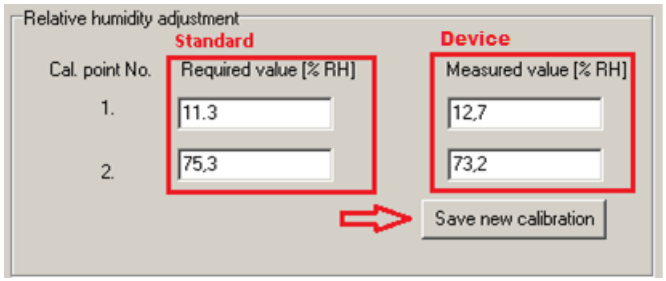



- **Temperature adjustment**. Is usually not necessary to adjust the temperature of Digi probe. For adjustment enter the measured values of the standard and the device. Click *Save new calibration* button finally:



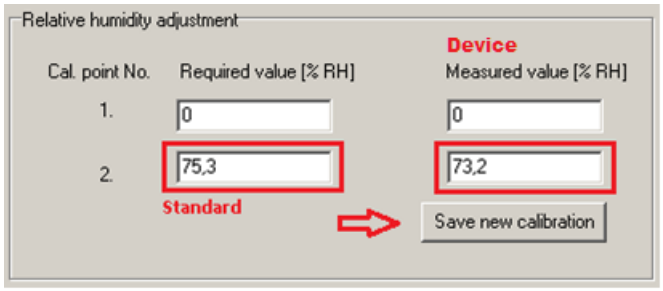

*If the device measured 25.2 °C before adjustment, then after procedure will measure 25.5 °C.*

- **Relative humidity adjustment**. Enter the measured values of the standard and the device. Click *Save new calibration* button finally:



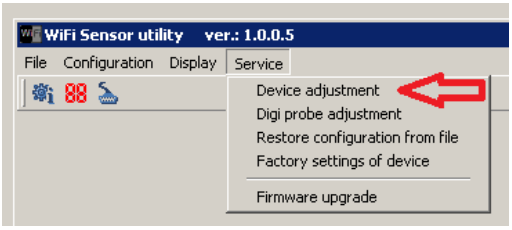

*If the device measured 73.2 %RH before adjustment, then measures 75.3 %RH after it.*

**Important note:** Capacitive humidity sensors usually drifts at high humidity and not at low humidity values. In most cases, it is sufficient to perform a one-point adjustment in higher humidity as show at image:

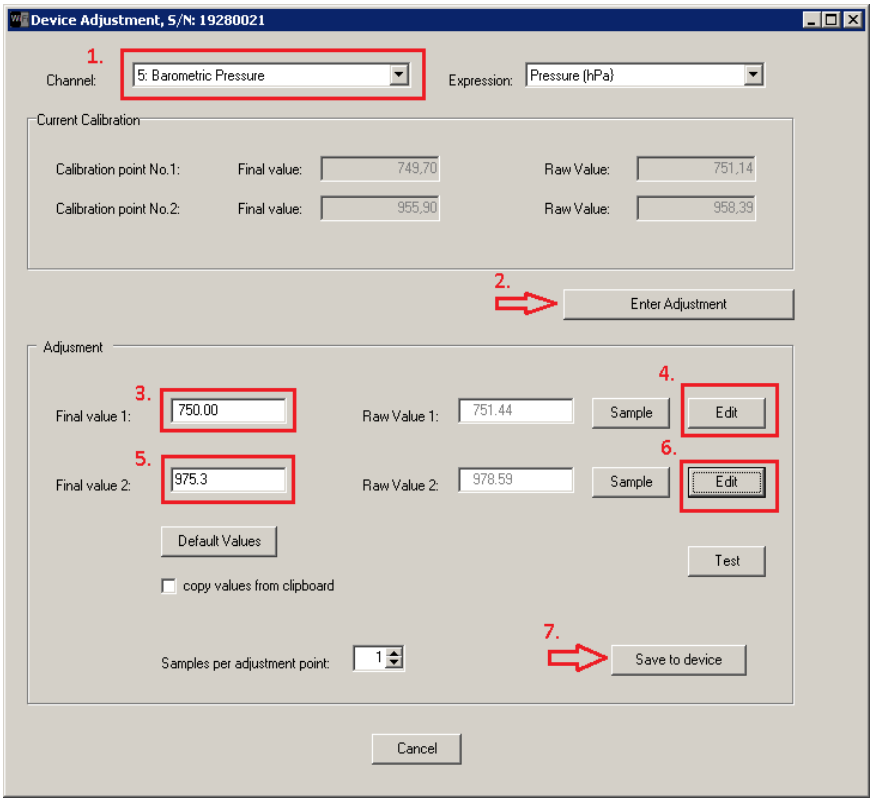


# Barometric pressure adjustment (W4710, W7710)

- select *Service – Device adjustment* menu item:




- two-point calibration:

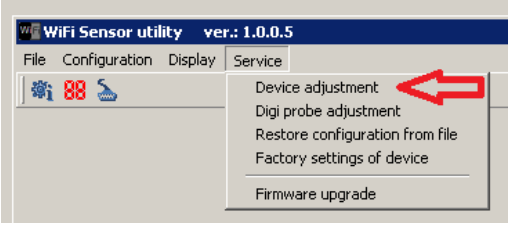



- select *Barometric Pressure* channel (1)
- Click *Enter Adjustment* (2)
- Enter standard value for calibration point No. 1 (3)
- Enter device value for calibration point No. 1 (4)
- Enter standard value for calibration point No. 2 (5)

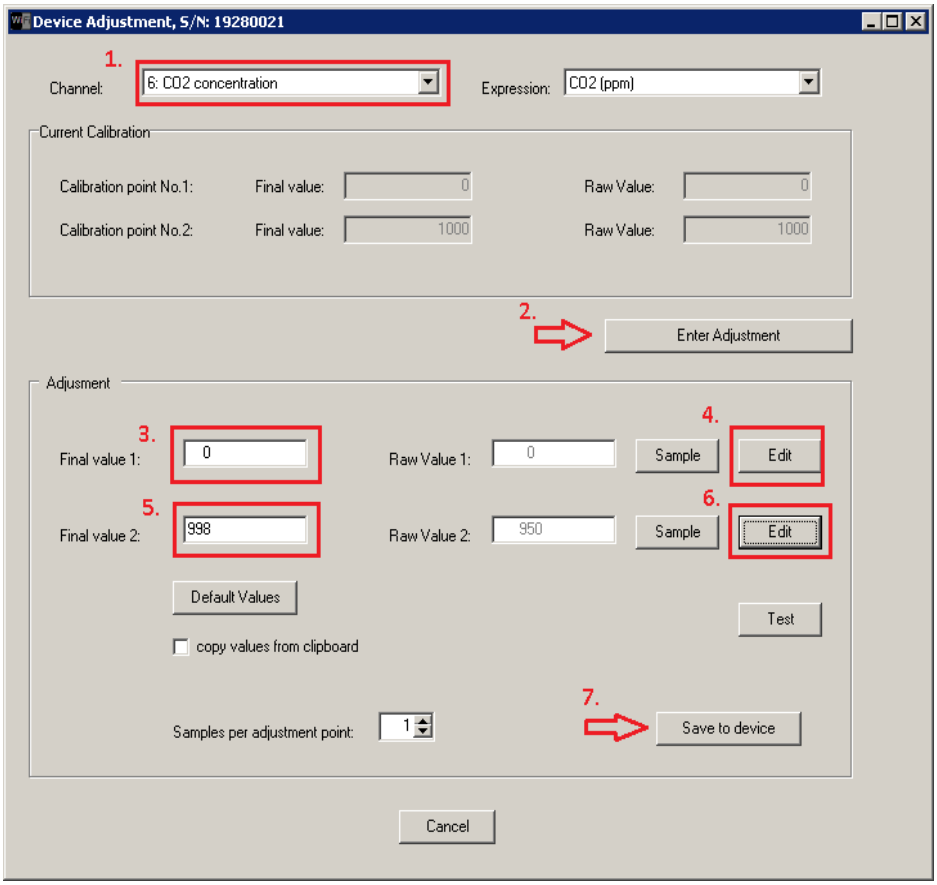
- Enter device value for calibration point No. 2 (6)
- Save new calibration to device (7)

## CO2 concentration Adjustment (W4710, W5714)

- select *Service – Device adjustment* menu item:




- one-point offset can be used:




- select *$CO_2$ concentration* channel (1)
- Click *Enter Adjustment* (2)

- Enter a zero value (3)
- Enter a zero value (4)
- Enter standard value for calibration point (5)
- Enter device value for calibration point (6)
- Save new calibration to device (7)

# Revision history

| Document version | Date | Note |
|---|---|---|
| IE-WFS-KAL-WiFi-01 | January 2021 | Initial document version |

Note: Page numbers may to differ between document versions.