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36XiW CTD conductivity calibration

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Abstract This document contains additional information for conductivity of KELLER Level Probes. As well as clarifications to conductivity calibration software.

1 Introduction

The KELLER 36XiW CTD sensor is designed to measure water level, temperature and electrical conductivity of groundwater and surface water, as well as brackwater and seawater.

The KELLER 36XiW level probe is available with a conductivity sensor and an accurate temperature sensor (PT1000). The conductivity sensor has an accuracy of +/-1% at measuring ranges of 0.2 / 2.0 / 20.0 / 200.0mS/cm, and the temperature sensor of +/-0.1°C.

The electrical conductivity in the 36XiW CTD is the ratio of current to voltage which is measured by a six electrode method. The 6 electrodes have to be fully submersed into the liquid that requires measuring to gather valid conductivity readings, if the electrodes are not fully submersed then the readings will be incorrect.

General specification can be found on the datasheet of the 36XiW (CTD).

2 General description of configuration settings of conductivity sensor

The commands for communication via RS485 and SDI-12 are available on the KELLER website at the corresponding communication protocols.

2.1 Conductivity range selection

The conductivity sensor offers four measuring ranges for measuring the conductivity. To achieve best possible accuracy, it is highly recommended to choose the appropriate measuring range, which fits best to the expected measuring values. For example, if the measuring range chosen is too large the accuracy of the measured value may be too low.

2.2 Calibration of single measuring range

It is possible to carry out a calibration for each measuring range of the conductivity sensor by assigning an individual gain.
Please note: for correct calibration, select the desired temperature compensation method and adjust the temperature gradient first.

2.3 Temperature compensation of conductivity

The conductivity sensor measures a raw value which is highly dependant on the temperature of the monitored liquid. That is why temperature compensation is carried out. This compensation is based on the norm EN27888 (determination of electrical conductivity for natural water, wastewater and mud). In this norm, there are three different kinds of compensation methods:

Linear compensation @ 25°C	KELLER uses as standard temperature gradient of 2.2%/K which fits well for solutions with middle to high conductivity.
Linear compensation @ 20°C	A temperature gradient in the range of 0 to 8% is needed. The compensation method with reference to 20°C is deprecated and mostly replaced by the method based on 25°C reference temperature.
Non-linear compensation @ 25°C	Compensation values are derived out of a table described in the norm DIN/EN27888. This non linear temperature compensation is appropriate for natural water as groundwater, surface water, tap water and wastewater.
Non temperature compensated conductivity	is available for customers who like to use there own temperature compensation for their application.

2.3.1 Evaluation of temperature compensation gradient

The temperature gradient is evaluated as following: Correct values of the temperature gradient can be found in literature describing well known salt solutions and typical mixtures (blendings) of ions. Of course it's also possible to determine a value for the temperature gradient experiential. For the experiential determination, two conductivity measurements of the same solution with different temperatures have to be made (read out raw value). One of the measurements has to be made at reference temperature and the second one at probe temperature. With the following formula it is possible to calculate the temperature gradient.

$$\alpha = \frac{(\kappa_{T2} - \kappa_{T1}) \cdot 100\%}{(T_2 - T_1) \cdot \kappa_{T1}}$$

$$\kappa_{T1} = Conductivity\ @\ reference\_temperature$$

$$T_1 = reference\_temperature(25°C)$$

$$\kappa_{T2} = Conductivity\ @\ probe\_temperature$$

$$T_2 = probe\_temperature$$

$$\alpha = temperaturegradient(\% / °K)$$

3 Environmental influence on conductivity

The measured conductivity values can be influenced by air bubbles around the electrodes, deposits on the electrodes or close by, as well as by solid objects to close by the sensor, as for example tight pipes.

3.1 Cleaning

The conductivity sensor should be flushed after each usage with deionised or distilled water. If there are some deposits, they should be carefully removed with a cotton bud and a mix of vinegar and water or light soap water. Abrasive cleaning detergents must not be used. Please note: Handle the electrodes with care. Mechanical stress, roughening of electrode surface or even scratches must be avoided.

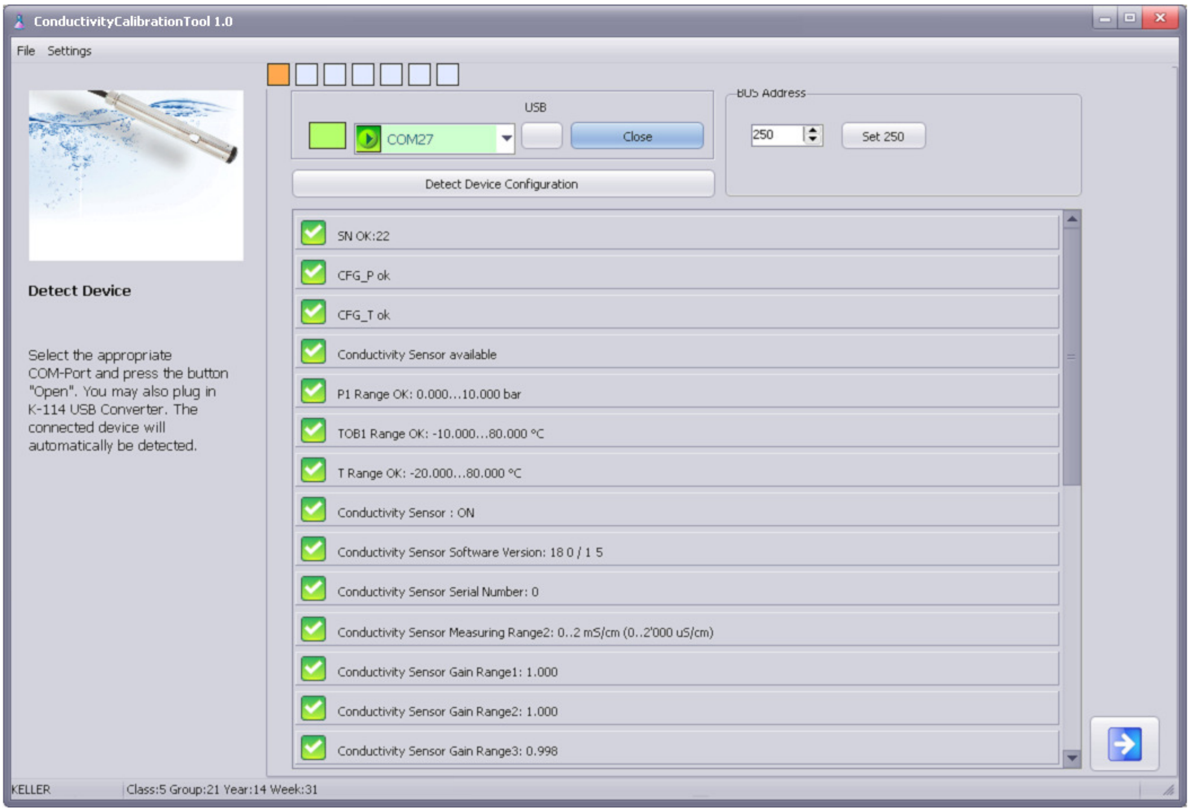
4 Calibration of conductivity sensor

KELLER offers software, called ConductivityCalibrationTool, which explains and calibrates the conductivity sensor step by step. This software works only over RS485 interface (Keller-/Modbus communication protocol), so it is necessary to set the probe to RS485 communication mode first and strictly follow the software instructions. The calibration software can be downloaded from the KELLER website.

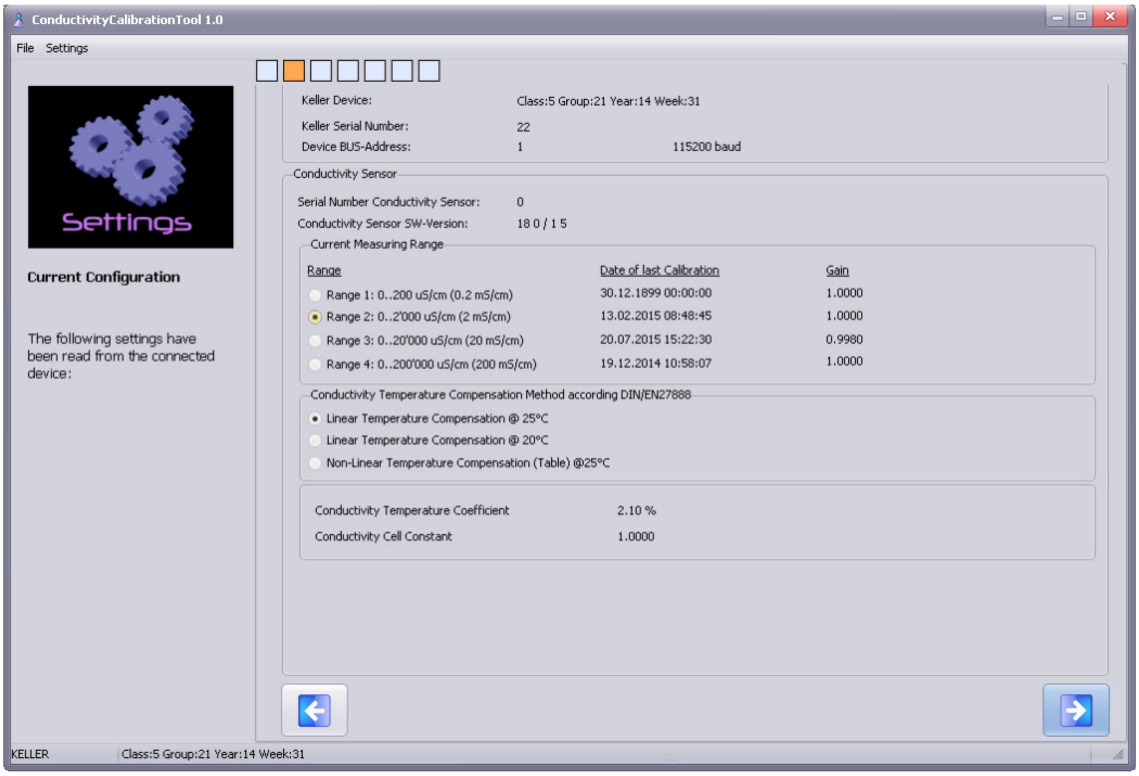
4.1 Calibration software for conductivity sensor

The sensor has to be connected with a serial interface converter RS485 to RS232 or USB. Select the correct com port and press the button "Open". The software reads all information and the current configuration from the device. The picture below shows the result when a device has been successfully recognised and scanned.
When the initial scan of the device has been successfully completed, the navigation button located in the bottom right corner becomes enabled. Press the navigation button to proceed to the next step.

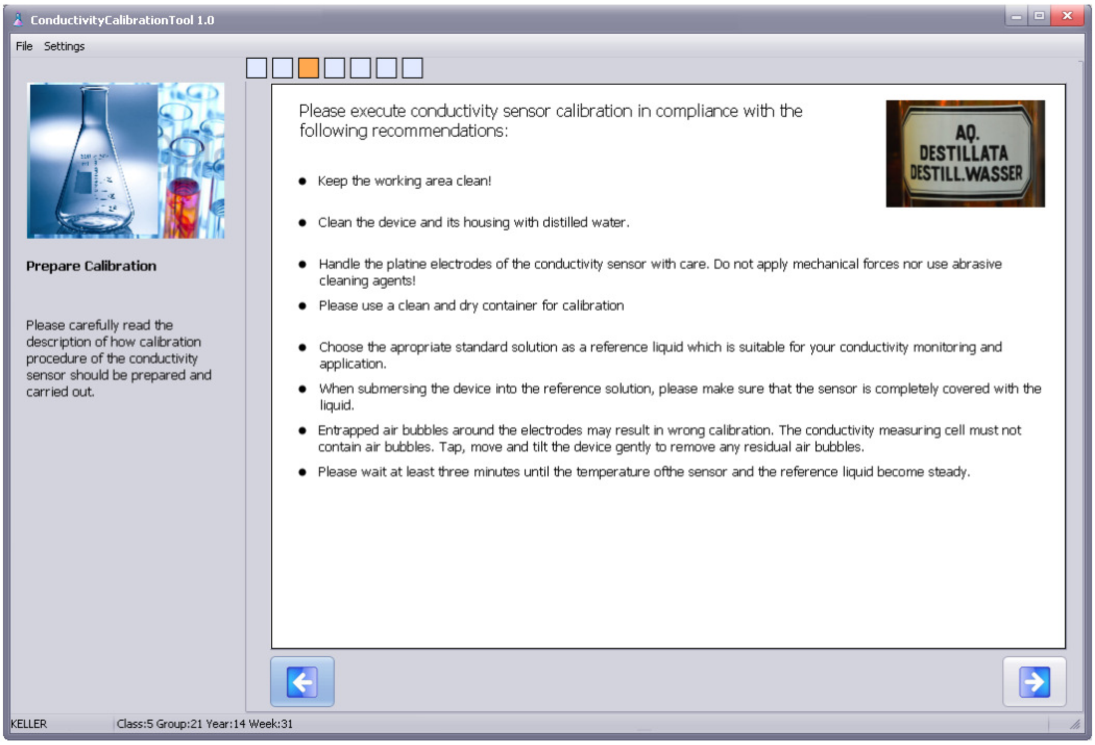
(The handling of each window of the software is described on the left side, below the picture.)



The conductivity range, to calibrate should be chosen. It is only possible to calibrate one range at a time. Further, the kind of temperature compensation method has to be selected. Additionally, further general information is displayed.

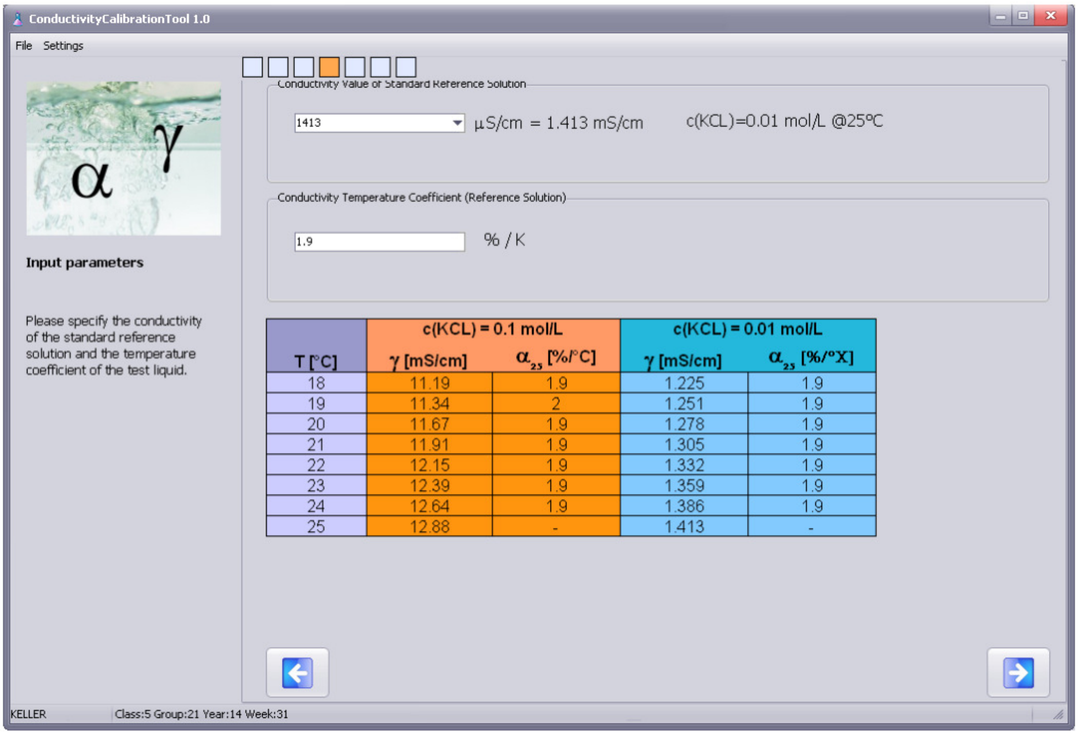


The steps mentioned in this window are important. For a correct calibration it is essential to follow them carefully.

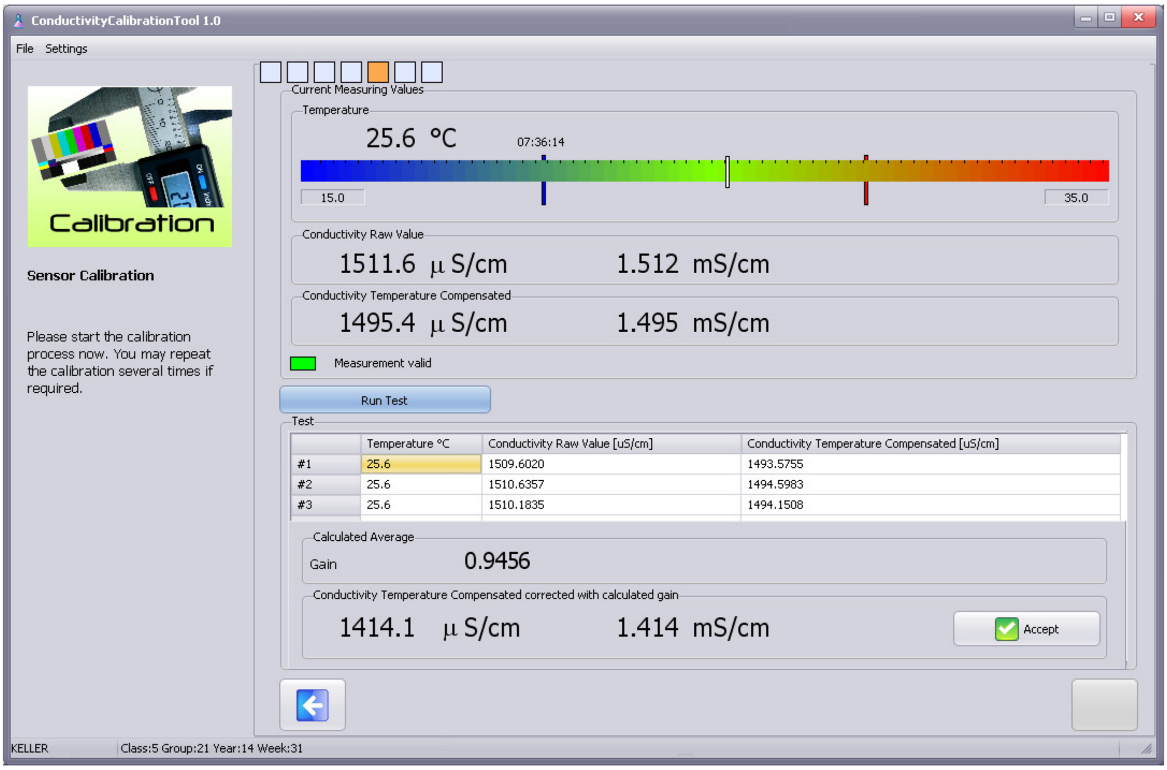


- Working area should be clean
- Device and whole housing should be cleaned with distilled water
- The platinum electrodes of the conductivity sensor should be handled with care. They do not tolerate mechanical forces or abrasive cleaning agents.
- For calibration, a clean, dry and big enough container should be used.
- An appropriate standard solution for the conductivity application should be chosen as reference liquid.
- The device should be submerged with the reference solution.
- Trapped air bubbles in the area of the electrodes will lead to wrong calibration. The device should be moved gently till the bubbles have cleared out.
- It takes at least three minutes until the temperature of the sensor and the one of the reference liquid become steady.

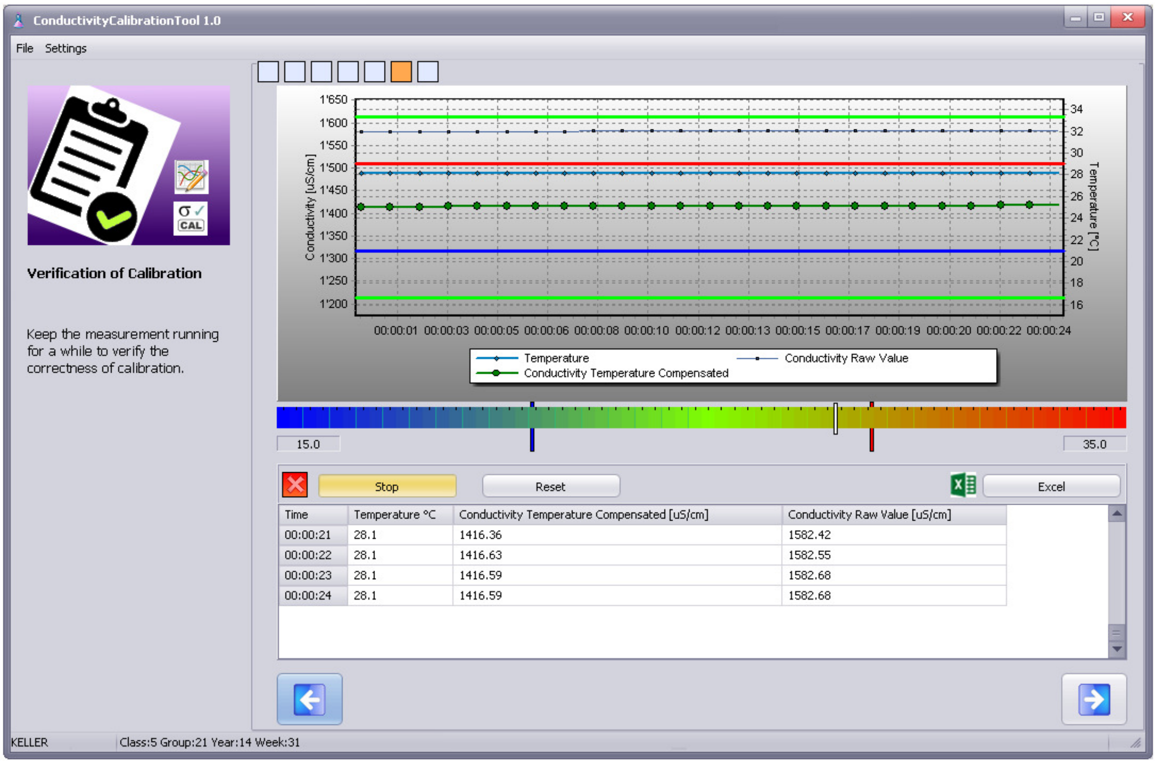
Parameters of the used calibration solution need to be filled in. The parameters of two different standard solutions are provided, but it is possible to use any solution for calibration as long as the required parameters are available.



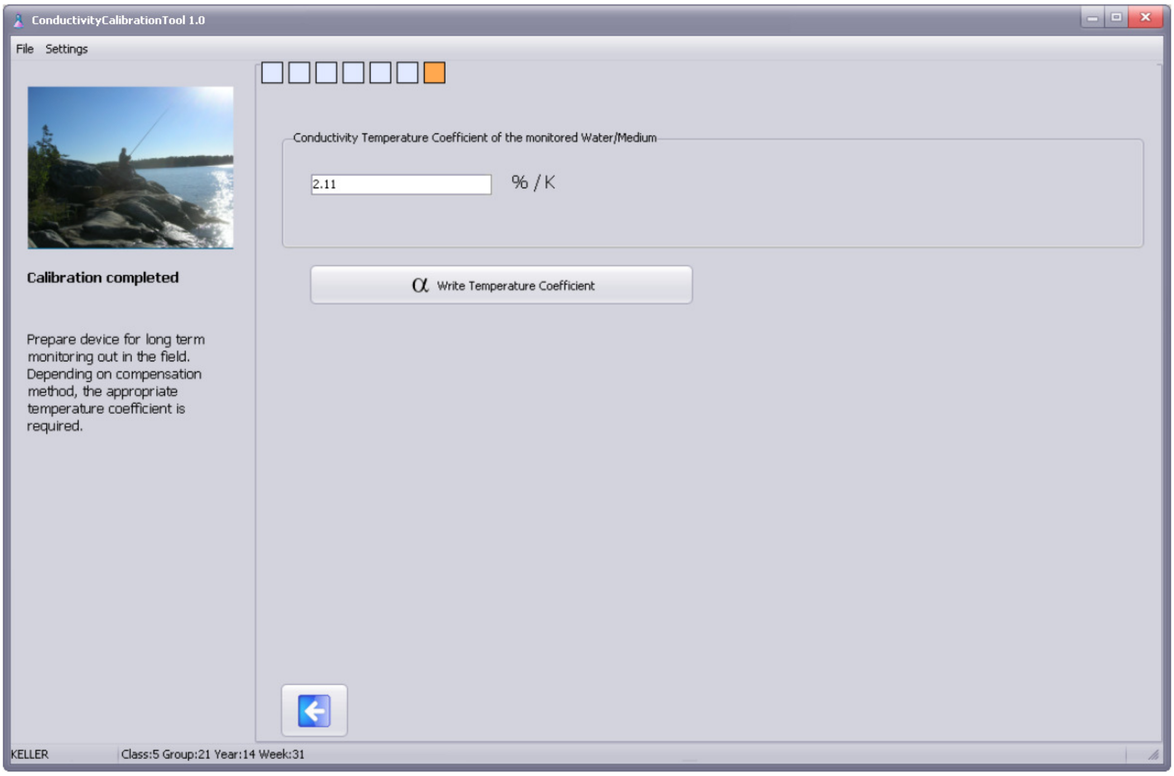
The white bar on the temperature scale has to be between the blue (lower limit) and the red (upper limit) bar. Otherwise, it is not possible to run the test. The closer the temperature to 25°C (or in case of compensation on 20°C at 20°C), the more accurate the compensation will be. (Under settings it is possible to change the limits as well as the count of measurements for test and the maximum gain variation.) After pressing the button "Run Test", the adjusted count of measurements is taken and out of the average value, the gain is calculated and displayed. By pressing the button "Accept", the calculated gain is set.



After calibration, the conductivity of the solution should be measured for a while for verification.



After finishing the calibration, the temperature gradient of the liquid used to measure should be recorded and written on the probe. Now the probe is ready for measurement in field applications. Temperature coefficient is only required for linear compensation, but to finish the program the button “write Temperature Coefficient” should be pressed. Afterwards it is possible to set the device to SDI-12 Mode if needed.



5 CCS30 Software for 36XiW

The 36XiW CTD is fully integrated in the CCS30 software for data acquisition and visualisation of configuration. For calibration of the conductivity sensor the ConductivityCalibrationTool Software is needed.

The only possible setting for the conductivity sensor in CCS30 is the range. The other configurations for conductivity are only possible with the calibration software. In CCS30 software the conductivity channels are called:

ConTc:	Conductivity value temperature compensated after the selected method
ConRaw:	Conductivity value without temperature compensation (This value can be used, if another kind of temperature compensation is needed. The temperature for temperature compensation of conductivity is available on channel T.

6 Appendix

6.1 Changes

- **Document version 1.0**: Release version

6.2 Support

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