



Manual for Calibration (accuracy verification) and Adjustment for Dataloggers Uxxxx(M)

Uxxxx(M) Calibration Manual (accuracy verification)

To verify the measurement accuracy (calibration) of temperature, relative humidity, CO₂ and barometric pressure, special equipment for generating these quantities (calibration chamber) is required. Calibration of the instrument is performed by placing the device under test (Datalogger) in the calibration chamber and comparing the Datalogger data with the standard data.

To verify the CO₂ concentration measurement of Dataloggers with an internal sensor, we recommend purchasing the “Adapter for CO₂ Adjustment and Calibration of Dataloggers COMET”, **order code LP104** (see QR code for details).



Calibration recommendations

The calibration interval is determined by the user of the device on the basis of the manufacturer's recommendations and also according to the requirements of the application in which the Datalogger is used. The manufacturer's recommended calibration intervals are given in the User Manual. In some cases, 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 Datalogger by its parameters. As a rule, the instruments are checked for accuracy specified by the manufacturer, however the user of the Datalogger 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 chamber, resolution of instruments, etc.). This uncertainty must be better than the required instrument accuracy in order to evaluate the measurement accuracy of the instrument. The determination of uncertainties is performed according to document EA-4/02. For each measuring point, the standard value, the measured value of the instrument and the measurement uncertainty shall be reported. The evaluation can be added.
- The standards used must be metrologically linked to the valid higher standards. A reference gas of known concentration (for CO₂) or a calibration solution (for relative humidity) may also be used as a standard. For the selection of a suitable standard it is sometimes simply stated that its accuracy should be at least 3 times better than the accuracy of the inspected Datalogger. However, this is only an indicative rule.
- When calibrating physical quantities, the standard in the chamber must be placed as close as possible to the sensors of the calibrated Datalogger. The distribution of temperature and relative humidity in the chamber may not be completely homogeneous and due to improper placement the measurement 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 value of the standard is not affected by the heat transfer between the chamber and the environment - especially over the cable to the sensors of standard.
- When calibrating the temperature and the relative humidity, the airflow in the chamber must be about 0.5 to 1 m/s. When calibrating the CO₂ concentration, the recommended calibration gas

flow rate is 1 l/min. We recommend using the **LP104 adapter to calibrate the CO₂ concentration for devices with an internal sensor**. However, if the entire Datalogger is inserted into the chamber when calibrating the CO₂ concentration (without LP104 using), we recommend unscrewing the bottom lid of the box 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 Datalogger is used. Temperature, relative humidity, CO₂ and pressure generated by the calibration chamber must not exceed the measuring range of the Datalogger.
- The time for starting and stabilizing the calibration chamber must be known in advance or can be reliably ascertained during calibration, eg. 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 controlled Datalogger 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 percents.
- For Dataloggers with external probes it is advisable to place only an external probe in the calibration chamber generating the relevant quantity. If the calibration is carried out at different temperature than ambient temperature, a part of the cable must be inserted together with the probe to prevent the measurement from being affected by the heat transfer between the chamber and the environment through the cable.
- Some external temperature probes can also be calibrated in a calibration furnace in air or liquid if the probe design allows. When calibrating in liquid, it is necessary to prevent liquid from entering the 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 chamber well settled at a constant temperature. It is advisable to place the chamber on a temperature non-conductive pad. After stabilization (at least 2 hours) read the measured humidity from the Datalogger and use the value from the solution standard calibration certificate.
- Voltage and current inputs are usually calibrated with connected sensors. Special calibrators or measuring sources are used to calibrate or adjust the input itself. The procedure is analogous to that of physical quantities. If this type of input does not meet the specified accuracy, we recommend that the device should be sent for repair.

Preparing the Datalogger for calibration

- Perform an optical check for mechanical or other visible damage. In case of damage, hand over the device for repair.
- Check that the device is not reporting a weak battery. If so, replace the battery or charge it (only for models with rechargeable battery). Charging time depends on the current battery discharge level. Because the internal battery charging produces parasitic heat, the charging speed is intentionally slowed down when the device is switched on to avoid over-influencing the measured values. To provide device charging as quickly as possible, turn the Datalogger off first. When the device is switched off, the quick charging mode is automatically activated. A full charge of the battery is indicated on the device display usually within 6 hours. Start the calibration no earlier than 2 hours after disconnecting the charger.
- The measured values can be read directly from the LCD display of the Datalogger (the display must be switched on) or from the device's record.

- In case you are going to evaluate the measured values from the record, check the correct setting of the time in the device, whether the record is started, and set the appropriate record interval (10 s) in the device. Check or change the measurement interval setting. 10 s is recommended for temperature, relative humidity and pressure, 2 minutes for CO₂.

Calibration procedure

- Place the prepared Datalogger or its external probe into the calibration chamber. Place the probe of the measuring standard near the measuring sensors of the Datalogger. If you read the measured values directly from the LCD display of the Datalogger, place the Datalogger so that it is visible. ATTENTION - check that the **display shows the current measured values** (not Min/Max values).
- **Note:** some internal thermometer-hygrometers (U3120, U3120M, U3631, U3631M, U4130) manufactured prior to 2020 are recommended to be calibrated with the back cover unscrewed so that air can flow better into the Datalogger. Unscrew the lid, move it away from the top part or turn it by 90°. This does not need to be done for models with a CO₂ sensor with holes on the side.
- Close the calibration chamber, start it and set the desired calibration point value.
- **Wait for the device to stabilize. The device stabilization time can be counted from the moment when the controlled quantity has stabilized in the calibration chamber.** As a guide, at least three times the response time t₉₀ specified in the instrument manual for the calibrated quantity is selected. **For devices with internal sensors we recommend 60 minutes for thermometers (U0110, U0110M), 90 minutes for internal thermometers-hygrometers (U3120, U3120M, U3631, U3631M, U3430, U4130, U4440, U4440M), for CO₂ measurement (U3430, U4440, U4440M) with LP104 calibration chamber for 10 minutes. Note: For indoor thermometers-hygrometers U3120, U3120M, U3631, U3631M, U4130 manufactured before 2020, we recommend reading after 4 hours.**
- After this time, read the measured value of the standard and the value from the inspected Datalogger. If you are going to perform evaluation from the record, note the measured value of the standard and time.
- Set the chamber to generate the next value and repeat the above procedure for all required calibration points.
- When calibration is finished, remove the Datalogger from the chamber and evaluate the measurement (download the record if necessary).
- The instrument's accuracy for each calibration point is specified in its instruction manual. When evaluating the measured values, it is necessary to take into account the specific uncertainty of measurement (may vary for each calibration point).
- If high deviations are detected (temperature measurement error greater than 1 °C, relative humidity greater than + -5 %RH, pressure greater than 5 hPa or CO₂ greater than 10 % of the measuring range), **keep the record in the Datalogger, switch off the device** and contact the distributor or service department. In case of minor deviation, you can carry out device Adjustment (see below).

Uxxxx(M) Adjustment Manual

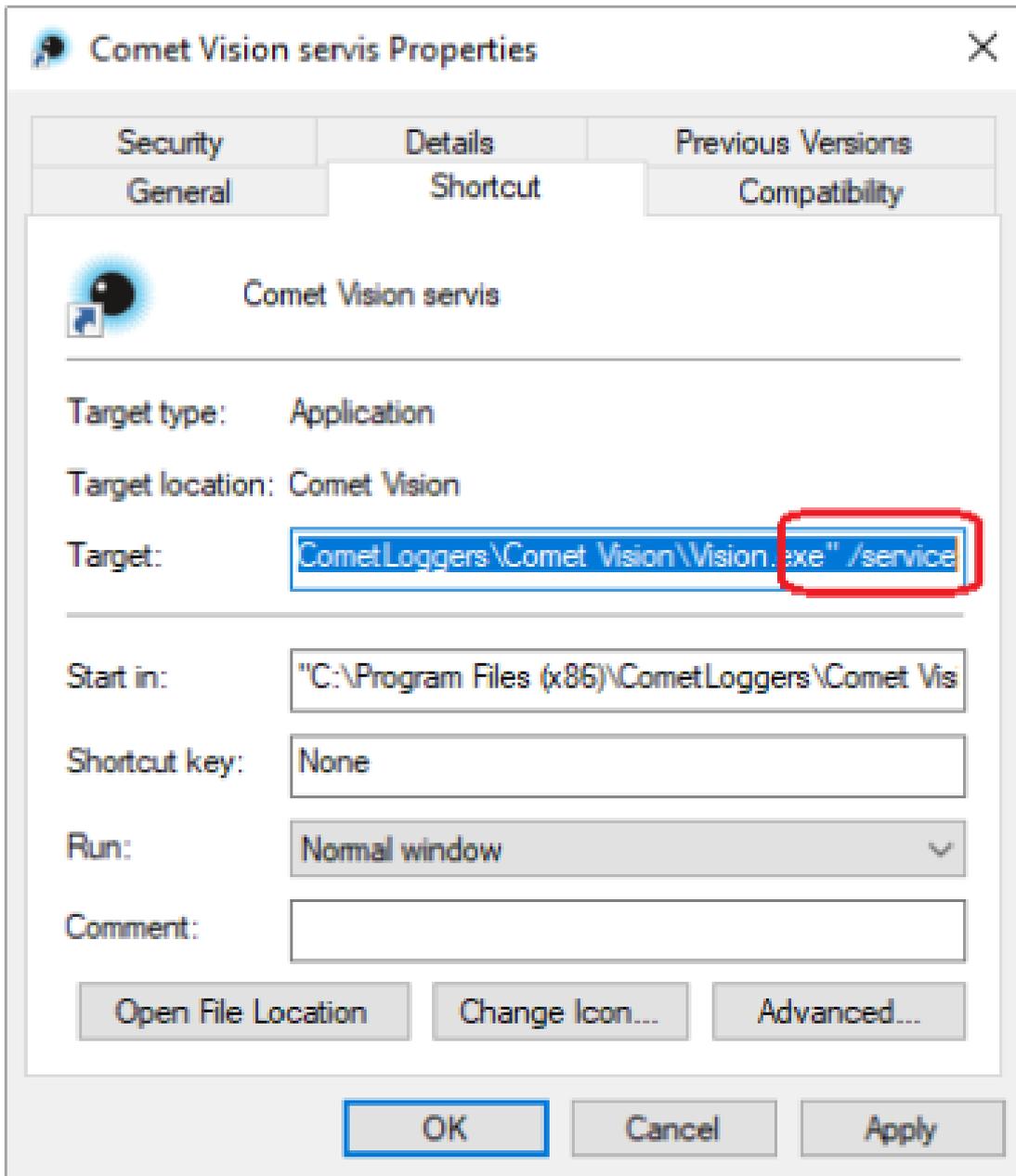
Adjustment means action resulting in setting Datalogger to the state, when its actual measurement accuracy is identical or better than measurement accuracy specified in instruction manual. Adjustment is possible only for measured values (temperature, relative humidity, CO₂ or pressure). For this operation, as well as for the calibration, a special equipment for constant temperature, relative humidity, CO₂ or pressure generation – a calibration box - is needed. Device adjustment is performed by placing the adjusted device to the calibration box and by consequent assignment of measured values to standard reading by means of the Comet Vision software.

Datalogger Adjustment Conditions

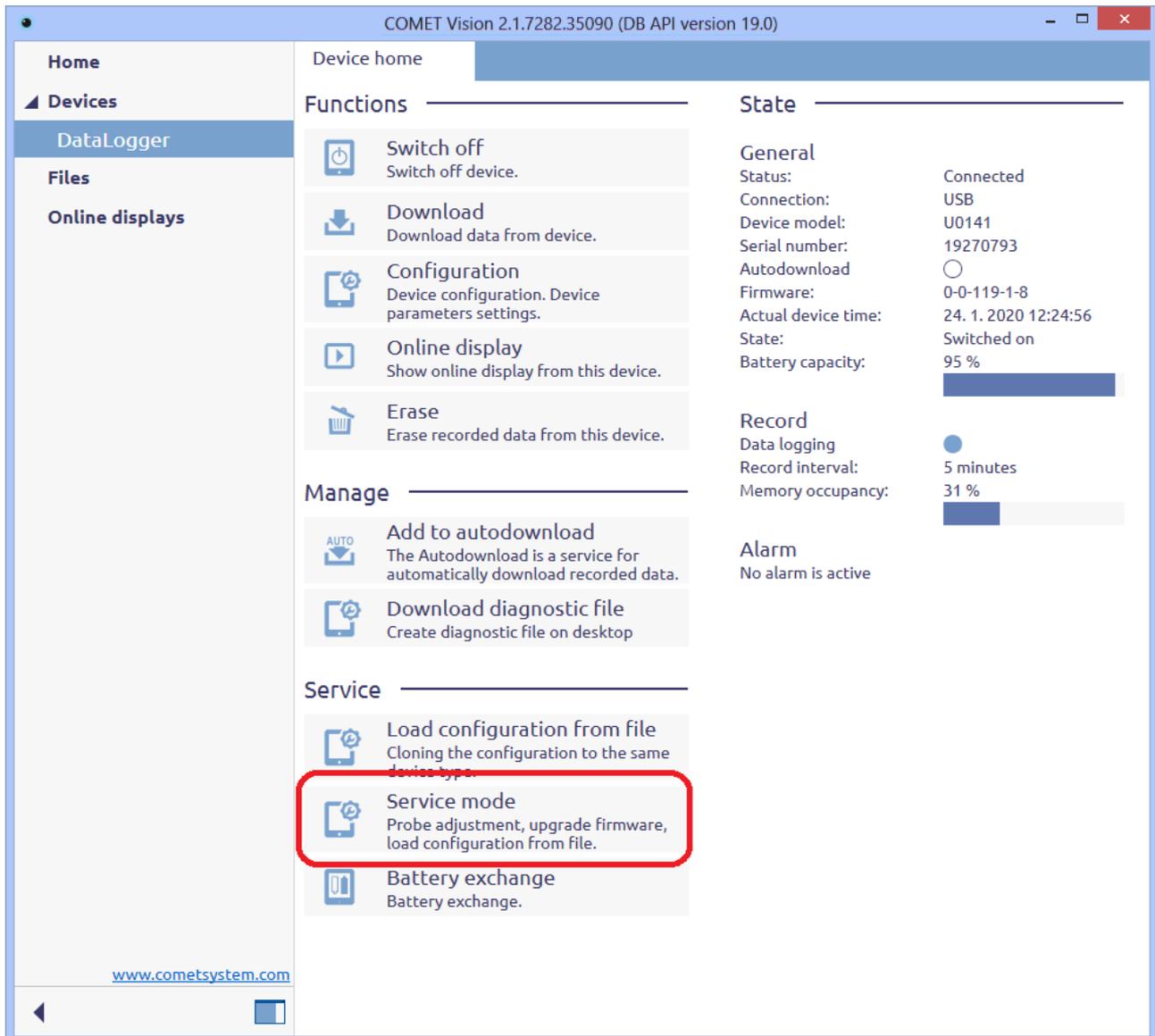
- Any unqualified entry into the instrument adjustment mode may rewrite the existing calibration constants and it can cause that the instrument will be unable to measure!
- Adjustment bears on calibration and that is why all conditions for Datalogger calibration must be kept, as for the device calibration described above.
- Adjustment of the measured value can be done in one point (Offset) or in two points (Advanced Mode), as far apart as possible within the required measuring range.
- 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 %RH and 80 %RH. When adjusting the humidity, **it is always recommended to perform a two-point adjustment, first adjusting the upper point in the range of 70 to 80 %RH**. Then verify the measurement accuracy (the lower point is usually not necessary to readjust).
- After the adjustment, it is always necessary to verify the correct measurement accuracy of the Datalogger (see the instrument calibration procedure).

Adjustment Procedure

- To adjust the Datalogger **use the users COMET Vision software**, which is available free of charge to download at <https://www.cometsystem.com/products/comet-vision-analytical-software-for-dataloggers-and-multiloggers/reg-cv>
- After installing the Comet Vision SW, it is necessary to modify the startup shortcut by adding the **/service** parameter. That means, find the shortcut to start Comet Vision on your desktop, right-click its icon and select *Properties*. Edit the "Target:" item by **adding a space** and **/service** at the end of the line after "... Vision.exe"



- Start the Comet Vision SW and connect the USB-C cable between the Datalogger and the PC. The menu item "Service mode" is displayed. To check the connection, **download the data record from the device**. It also serves as a backup of the original device settings.



- Check the device settings, the recording and the device must be running. Recording interval 10 s, measuring interval for temperature, relative humidity and pressure 10 s, for CO₂ 2 min. Check or eventually correct the time setting in the Datalogger.
- If the Datalogger is permanently connected to the USB cable during the adjustment procedure, the rechargeable battery needs to be fully charged beforehand. Charging time depends on the current battery discharge status. The battery charging process will be initiated only in the case that the battery voltage is low and the internal temperature ranges between 0 °C and 40 °C. Use the recommended charger type only. During the battery charging period the internal temperature of the device may be slightly raised, which can, for a short period of time, adversely influence the measurement values of the internal sensors. Therefore, the charging speed **with the power on is deliberately slowed down** to avoid excessive measurement influence. If you want to charge the device as soon as possible, turn it off first. When the device is turned off, the fast charging mode is automatically activated. Fully charged battery is indicated on the display of the device

usually within 6 hours. When charging is complete, unplug the charger and allow the device temperature stabilization for at least 2 hours.

- When adjusting the relative humidity, it is recommended that the Datalogger and the standard are stabilized at room humidity for at least 30 min.
- For Dataloggers with external probes, it is advisable to place only an external probe in the calibration chamber generating the relevant quantity. If the calibration is carried out at different temperature than ambient temperature, a part of the cable must be inserted with the probe to prevent the measurement from being affected by the heat transfer between the chamber and the environment through the cable.
- The measurement standard (temperature, relative humidity, pressure and CO₂) is also placed in the calibration chamber. **Proceed in the same way as described above for calibration.**
- Close and run the calibration chamber. Set to generate an **upper adjustment point** value.
- Wait for the device to stabilize. The device stabilization time can be counted from the moment when the controlled quantity has stabilized in the calibration chamber. After stabilization of the controlled quantity in the chamber at the required value for the upper point, time for device stabilization can be counted. Then note the time and value of the standard.
- Connect the Datalogger to the PC. Use Comet Vision software for the record download.
- Then select "Service Mode", Channel Adjustment and select the adjusted quantity/channel. For relative humidity adjustment, use "Advanced Mode". For the upper point, **enter the standard value in the "Final value 2" field**. Enter the value measured by the Datalogger (at the time of reading the standard) in the "Raw value 2" field. If the Datalogger is permanently connected to the PC during the adjustment, you can obtain the current Datalogger value by clicking the "Sample" button next to the corresponding field. Confirm the entry with the "Write" button.

The screenshot displays the 'U3430_19272078 - SERVICE MODE' interface. On the left, a 'Channel adjustment' sidebar lists five channels: Channel 1 (Temperature), Channel 2 (RH), Channel 3 (DewPoint), Channel 4 (CO2), and Channel 5 (Vbat). Channel 2 is selected. The main area shows 'Last adjustment data and time: 29. 11. 2019 6:46:53'. Under 'Current Calibration', two points are defined: Calibration point No.1 with Final value: 0% and Raw value: 0; Calibration point No.2 with Final value: 100% and Raw value: 100. The 'Adjustment' section shows Final value 1: 0% and Raw value 1: 0, and Final value 2: 80% and Raw value 2: 77,5. Red text labels 'Standard' and 'Device value' are placed below the 'Final value 2' and 'Raw value 2' fields respectively. Buttons for 'Sample', 'Offset mode', 'Read', and 'Write' are visible. At the top right are 'Back' and 'Leave service mode' buttons.

If the **pressure or CO₂ concentration** is measured, a one-point offset can be used. The entered value is based on the measured values. The example below causes the CO₂ measurement to shift up 15 ppm. Confirm the entry with the "Write" button.

The screenshot shows the 'SERVICE MODE' interface for device U3430_19272078. On the left, there is a list of channels: Channel 1 (Temperature), Channel 2 (RH), Channel 3 (DewPoint), Channel 4 (CO2), and Channel 5 (Vbat). Channel 4 is currently selected. The main area displays 'Last adjustment data and time: 29. 11. 2019 6:46:53'. Below this, there are two sections: 'Current Calibration offset' with a value of 0, and 'Set new offset' with a value of 15. A red box highlights the '15' in the 'Set new offset' field, with a red '1.' next to it. A yellow callout box points to the field with the text 'The value will be added to a raw value.' Below the 'Set new offset' section is an 'Advanced mode' button. At the bottom right, there are 'Read' and 'Write' buttons, with the 'Write' button highlighted by a red box and a red '2.' next to it. At the top right, there are 'Back' and 'Leave service mode' buttons.

- If two-point adjustment (for relative humidity, in Advanced Mode) is carried out, the chamber is preset to generate the lower point value. Wait for the device to stabilize. The device stabilization time can be counted from the moment when the controlled quantity has stabilized in the calibration chamber. After stabilization of the controlled quantity in the chamber at the required value for the lower point, time for device stabilization can be counted. Then note the time and value of the standard.
- Connect the Datalogger to the PC and download the recorded data into COMET Vision software.
- Compare the measured values of the Datalogger and the standard. If the detected result meets the required measurement accuracy, the adjustment process can now be terminated by pressing the "**Leave service mode**" button.
- Otherwise, continue to adjust the **lower point**. It means click on "*Service Mode*", *Channel Adjustment*, select the adjusted quantity/channel and use "**Advanced Mode**". For the lower point, **enter the value of the standard in the "Final value 1" field**. Enter the value measured by the Datalogger (at the time of reading the standard value) in the "Raw value 1" field. If the Datalogger is permanently connected to the PC during the adjustment, you can obtain the current Datalogger value by clicking the "Sample" button next to the corresponding field. Confirm the entry with the "Write" button.
- Adjustment process can be now terminated by pressing the "**Leave service mode**" button.
- After the adjustment procedure it is necessary to make Datalogger calibration procedure.