

Unisense UniAmp Multichannel Systems

User Manual



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1 Scope of the manual

This manual covers the multichannel versions of the UniAmp: fx-6 UniAmp, x-5 UniAmp, fx-3 UniAmp, and the customized multichannel versions.

2 Warranty and liability

The UniAmp meters are covered by a one-year warranty.

The warranty does not include repair or replacement necessitated by accident, neglect, misuse, unauthorized repair, or modification of the product.

In no event will Unisense be liable for any direct, indirect, consequential or incidental damages, including lost profits, or for any claim by any third party, arising out of the use, the results of use, or the inability to use this product.

2.1 Repair or adjustment

Equipment that is not covered by the warranty will, if possible, be repaired by Unisense with appropriate charges paid by the customer. In case of return of equipment please contact us for return authorization.

For further information please see the document General terms of sale and delivery of Unisense A/S as well as the manuals for the respective products.

3 Support, ordering, and contact information

If you wish to order additional products or if you encounter any problems and need scientific or technical assistance, please do not hesitate to contact our sales and support team. We will respond to your inquiry within one working day.

E-mail: sales@unisense.com

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Tueager 1
DK-8200 Aarhus N, Denmark
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Further documentation and support may be found at www.unisense.com

4 Overview

The multichannel UniAmp meters are compact and economical meters for the Unisense electrochemical microsensors, including the STOX sensors and optodes.

The meters come with different number and combination of channels. The channels are labelled:

- *pA* (Pico ampere) for amperometric sensors (O_2 , N_2O , H_2 , H_2S , NO , STOX)
- *mV* (millivolt) for potentiometric sensors (pH, redox)
- *Op* (optical) for oxygen optodes
- *T* (temperature) for temperature sensors

The standard multichannel UniAmp come in the following configurations:

- fx-6 UniAmp (2 x pA, 2 x mV, 1 x Op, 1 x T)
- x-5 UniAmp (2 x pA, 2 x mV, 1 x T)
- fx-3 UniAmp (1 x pA or 1 x mV, 1 x Op, 1 x T)



Figure 1: fx-6 UniAmp

All amperometric channels (pA) have support for the ultrasensitive STOX oxygen sensor with a detection limit of <math><10\text{ nM}</math>.

The fx6 and x-5 UniAmp are also available in customized versions, with the combination of channels decided by the customer.

The meters offer temperature compensation for all amperometric channels with a range of $\pm 3^\circ\text{C}$ from the calibration temperature. This will work if a temperature sensor is connected.

The UniAmp meters are USB-powered and fully integrated with the Unisense SensorTrace Suite software, allowing any combination of Unisense electrochemical sensors and optode technology.

The user interface consists of a pop-up window (a Microsoft Windows service) that is installed in the *Windows Notification Area*, also called *System tray*, in the lower right hand area of the screen. Using this pop-up, you can adjust channel settings such as pre-amplification, offset, sensor polarization etc.

5 Operating and setup conditions

The UniAmp meters are designed for laboratory use. Care must be taken to protect the amplifiers in humid, dusty, and corrosive environments (e.g. field conditions) since it may affect the performance, cause damage, or shorten lifetime. If the amplifier is used outdoors, it should be protected in a plastic bag or similar.

Temperature: 0 to $+50^\circ\text{C}$ (<math><90\%</math> rel. humidity, non-condensing)

Power: From PC, through the USB cable

Grounding: Through the USB cable. Ensure that the PC is properly grounded.

6 Installation and setup of UniAmp and software

The UniAmp instruments must be used with the SensorTrace Suite software. Install the latest version of the software, which can be downloaded from https://www.unisense.com/Software_download/.

The Logger and Programming Tool parts of the software suite are freeware, whereas Profile, Rate, and Photo require a license. The SensorTrace Suite is compatible with Windows versions 7 and 10.

6.1 Installation of the SensorTrace Suite software

Locate the *SensorTrace Suite Setup* file on your PC.

- Right-click on the file and select *Run as administrator*
- If you get the message *Windows protected your PC*, click *More info*
 - Click *Run anyway*
- If you get the message *Do you want to allow this app to make changes to your device?* click *Yes*
- In the *SensorTrace Suite Setup* window, accept license terms and conditions and click *Install*
- Follow the instruction on the screen to complete the setup
- If you have purchased a license, start one of the Suite applications (Logger, Profile, Rate, Photo), click *Help - Register license*

6.2 Connect the UniAmp to the PC

Connect the UniAmp to the PC using a USB-A to USB-C cable. The drivers needed for connection will automatically be installed. The Unisense UniAmp service is installed together with the SensorTrace Suite. Click on the UniAmp service icon to open a window with a frame for each sensor connected to the UniAmp (Figure 2).

NOTE: Only channels with a sensor connected will be shown!

The UniAmp instruments are powered through the USB cable and no external power supply is needed.

NOTE: The USB cable must be a high quality shielded cable!

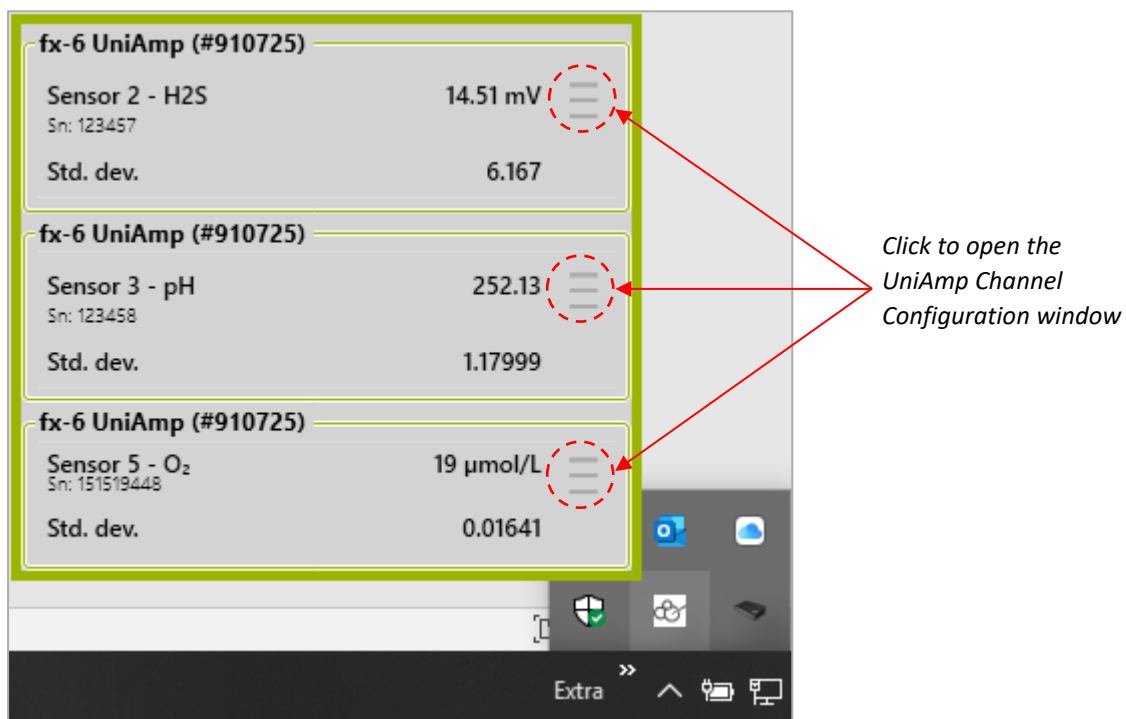


Figure 2: Unisense UniAmp service in the Windows Notification Area. Click the up-arrow to show hidden icons, then click the UniAmp service icon to open it. Only channels with a sensor connected, will be shown. Here sensors for H₂S, pH and O₂ are connected and shown. For each channel, the UniAmp Channel Configuration window may be opened by clicking the three grey lines (red circles), see Figure 3.

7 Getting started

The UniAmp instruments are powered from the PC through the USB cable and are operated through the Unisense UniAmp service in the *Notification Area* (Figure 2). Just connect the UniAmp to the PC and settings for the connected sensors will be available in the UniAmp service window.

7.1 Connecting sensors with automatic settings

Sensors are connected to the UniAmp by plugging in the 10-pin UniAmp connector. Amperometric sensors (O_2 , N_2O , H_2 , H_2S , NO , $STOX$) must be connected to pA-channels, pH and redox sensors to mV-channels, oxygen optodes to Op-channels and temperature sensors to T-channels. The E²PROM in the sensors will automatically set up the UniAmp for working correctly with the connected sensor (Figure 3) except for the N_2O sensor where a manual pre-polarization must be performed (see 7.3 *Manually setting the sensor polarization*).

The green light on the UniAmp will turn off for 0.1 second when a sensor is connected, indicating that the E²PROM has been read.

7.2 Manually setting the Pre-amplification

The Pre-Amp Range determines how the sensor signal in pico ampere (pA) is converted into a signal in millivolt (mV). This is set by the E²PROM in the sensor, when the sensor is plugged in, but can be changed manually. Simply select the Pre-Amp Range you want from the drop-down menu (Figure 3).

The default setting of 1 pA = 1 mV works in most cases. However, if you work with a custom sensor with either a very low or high signal, it may be beneficial to change this. Also, for sensors that don't have the 10 pin UniAmp connector and that are connected through an adaptor, it may be necessary to select the Pre-Amp Range manually.

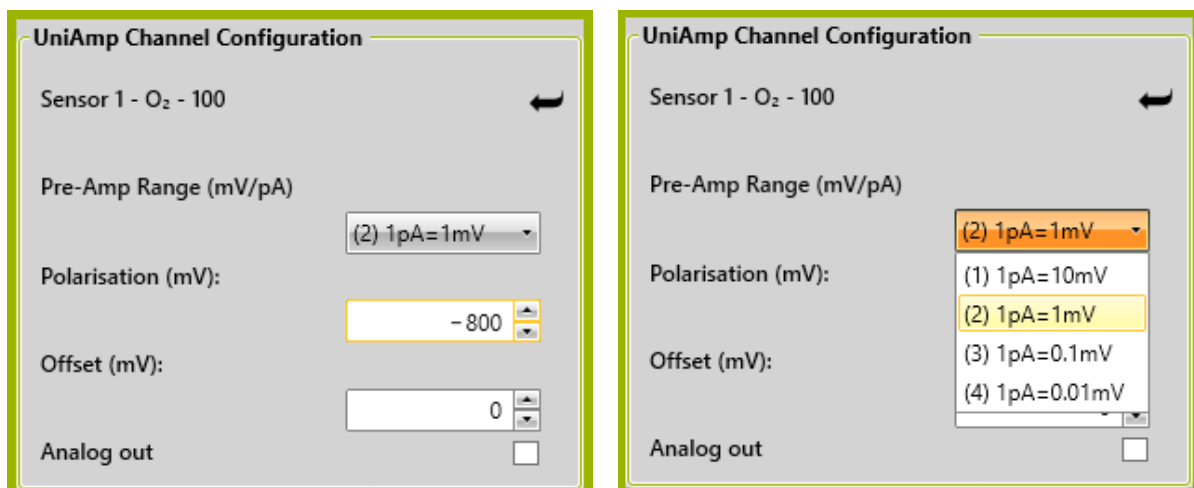


Figure 3: UniAmp Channel Configuration window. Here an O_2 sensor is connected and the preset values loaded from the E²PROM are shown to the left. The dropdown menu for the Pre-Amp Range setting is shown to the right. This window is opened as described in Figure 2. The "Pre-Amp Range" and "Polarization" boxes are not available for pH and redox microelectrodes.

7.3 Manually setting the sensor polarization

All amperometric sensors (O_2 , N_2O , H_2 , H_2S , NO , $STOX$) must be polarized and the correct polarization depends on the sensor type. This is set by the E²PROM in the sensor, when the sensor is plugged in, but it can also be set manually. Simply enter the value you want in the *Polarization* box (Figure 3).

NOTE: Wrong polarization may destroy the sensor

For most sensors, the polarization will never need to be modified. The N₂O sensor requires that the polarization is adjusted manually as this requires a period of pre-polarization at a more negative polarization before it is set to the measuring polarization (see the Nitrous Oxide Sensor Manual. To be downloaded at: <https://www.unisense.com/manuals/>).

7.4 Adjusting the offset

The Offset may be set manually. It may be used to displace the signal in a positive or negative direction (Figure 3).

7.5 Setting STOX sensor parameters

The STOX sensor is a double O₂ sensor, one sensor acts as the measuring sensor and the other acts as the front guard. The front guard will, when it is polarized, prevent O₂ from reaching the measuring O₂ sensor. The measuring signal, with the front guard on, is thus the signal for zero oxygen. The measuring signal, with the front guard off, is thus the signal for O₂. This difference in signal with front guard on and off is proportional to the O₂ concentration. Please see the STOX Sensor Manual for details (<https://www.unisense.com/manuals/>).

The cyclic polarization of the front guard must be set individually for each sensor depending on the sensor characteristics. See the STOX sensor manual for details.

When a STOX sensor is connected to a pA channel, the *Enable STOX-mode* checkbox will be available (Figure 4). Check this box to display the *STOX zero on-time (s)* and *STOX zero off-time (s)* fields.

Setting the cyclic front guard polarization timing (seconds):

- The front guard on period is specified in the *STOX zero on-time (s)* field
- The front guard off period is specified in the *STOX zero off-time (s)* field

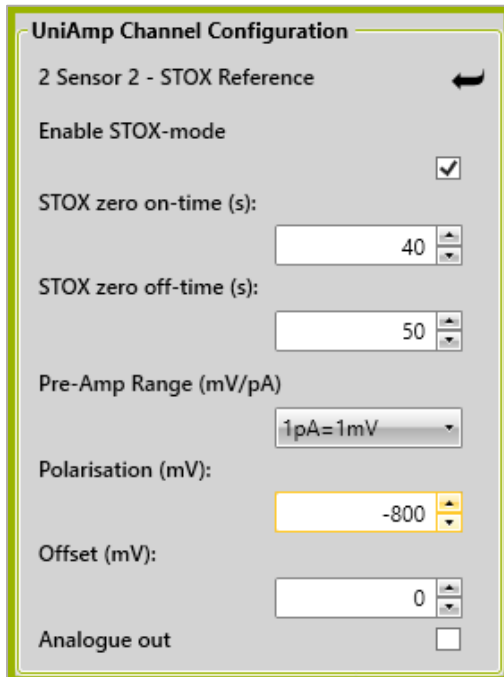


Figure 4: UniAmp Channel Configuration window with a STOX sensor connected. The Enable STOX-mode must be checked to display the two STOX zero on/off time fields.

7.6 Polarizing amperometric sensors without a PC connected

Amperometric sensors generally perform best after being polarized for a few hours, preferably overnight. If you don't have a PC available for powering the UniAmp, you may connect it to a USB charger, i.e. an iPhone charger, or a power bank designed for smartphones. Plug in the sensors you want to be polarized and the E²PROM will ensure correct polarization.

NOTE: N₂O sensors will be polarized at the measuring polarization. Before use, it is necessary to manually do the pre-polarization. Please see 7.3 *Manually setting the sensor polarization* and the Nitrous Oxide Sensor Manual. To be downloaded at: <https://www.unisense.com/manuals/>.

8 Sensor connections and compatibility

8.1 Sensors, connectors, and adaptors

Sensors for the UniAmp meters must have the 10 pin UniAmp connectors. This connector will identify the sensor type for the UniAmp, so that the instrument will be adjusted to the specific sensor connected. For the amperometric sensors, the polarization will be set automatically except for the N₂O sensor (see 7.3 *Manually setting the sensor polarization*).

The 6 pin connector for the legacy Unisense Multimeter requires an adaptor to be used with the UniAmp instruments. If using sensors via adaptors, the sensor polarization has to be set manually, using the Unisense pop-up window residing in the Windows *Notification Area* (see 7.3 *Manually setting the sensor polarization*).

8.2 Grounding

The UniAmp instruments are delivered with a grounding cable with a banana plug at one end and a silver wire at the other. This is for use with amperometric sensors only.

Grounding may help reducing electrical noise when working in environments with high levels of such noise.

Note: Never use the grounding cable with pH and redox sensors.

For grounding the measuring setup, the banana plug is plugged into the connector on the back of the instrument and the silver wire is dipped into the liquid where the sensor is inserted (calibration standard, sample, water bath etc.). This will remove any difference in electrical potential between the liquid and the sensor.

The PC must be connected to a proper grounding through its power supply and the mains cable. Make sure that the mains supply is properly grounded.

NOTE: Some microsensors may only be used if the grounding cable is used. These sensors are marked *Grounding cable must be used to keep warranty!* In this case the grounding must be established as described above before the sensor touches the liquid and the cable must remain in place as long as the sensor is used in the liquid.

8.3 Software

The UniAmp instruments require the latest version of the SensorTrace Suite software. Check the version of your software in any of the applications (Logger, Profile, Rate, Programming Tool, Photo) by clicking *Help - About*, or right click the UniAmp service in the *Notification Area* and select *About*. If you are not already running the latest version of the SensorTrace Suite, please download (https://www.unisense.com/Software_download/) and install it (see 6.1 *Installation of the SensorTrace Suite software*).

9 Analog in and out

The Analog in/output is located on the back of the instrument (Figure 5). Using an adaptor, it is possible to retrieve the analog signals from all sensors for use with external analog to digital converters. The Analog out must be activated in the UniAmp service window (Figure 3). Contact sales@unisense.com if you need the adaptor. For connection to non-Unisense equipment, contact Unisense first, to avoid damage to the instrument.



Figure 5: Connectors for Analog and Digital in and output and for the grounding cable (right).

10 Digital in and out

For future implementation and for service purposes.

11 Auxiliary equipment

Unisense provides solutions for a range of experimental setups, including bulk measurements, microprofiling and micro-respiration. Depending on your measuring requirements, you may need additional equipment for positioning, calibration, sample fixation, etc.

Please visit <https://www.unisense.com/> for inspiration and contact Unisense for any questions you may have.

12 Temperature compensation

12.1 Electrochemical sensors

With the UniAmp it is possible to automatically correct the sensor signal for changes in temperature for the amperometric sensors for up to $\pm 3^{\circ}\text{C}$ from the calibration temperature. The compensation may be turned on and off in the calibration window for each sensor by clicking the *Temperature compensation* checkbox. To use this option, you must specify the temperature input it to be used for the temperature correction. This may be:

- A fixed temperature, that you enter manually
- The input from a temperature sensor. This sensor must be selected from the dropdown menu on the calibration window for each amperometric sensor.

The temperature correction of the sensor signal is automatically performed by SensorTrace (if this option is turned on, see above) by applying this formula to the sensor signal:

$$Signal_{Comp} = Signal_{Meas} \times (A_{number})^{(T_{Cal} - T_{Meas})}$$

Where:

- $Signal_{Comp}$ is the temperature compensated signal
- $Signal_{Meas}$ is the non-temperature compensated signal from the sensor
- T_{Cal} and T_{Meas} are the temperatures at calibration and at measuring
- A_{number} is the temperature compensation constant.

The unit for the two *Signals* is that selected in *Settings* the *Start Experiment* window (Figure 6).

The A_{number} for each sensor is specified on the sensor E²PROM under factory calibration. This value has been obtained as the average value for 8 individual sensors of the same type. It is also possible for the user to determine this constant for a sensor and to enter it manually in the calibration window for this sensor.

See the *SensorTrace Suite User Manual* for details on how to calibrate sensors.

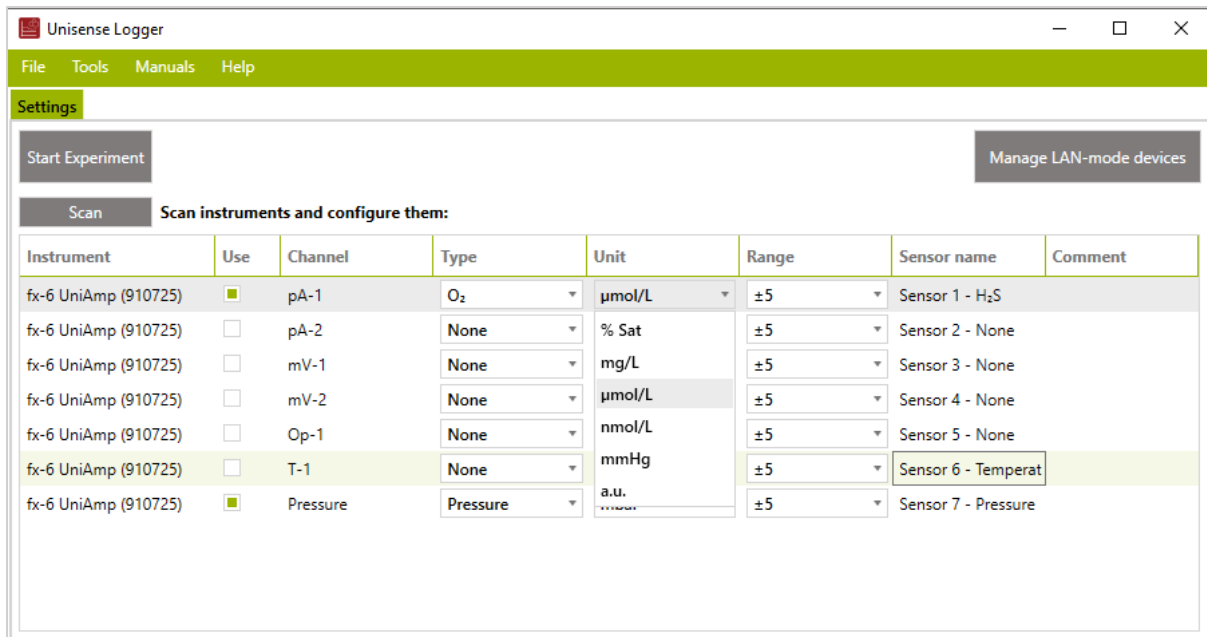


Figure 6: The Start Experiment window in SensorTrace Suite. The dropdown menu for channel pA-1, (O₂) is unfolded to show the available units.

12.2 Oxygen optodes

With the UniAmp it is possible to automatically correct the sensor signal for changes in temperature. The temperature use for correction may be:

- A fixed temperature, that you enter manually
- The input from a temperature sensor. This sensor must be selected from the dropdown menu on the calibration window for each sensor.

See the *SensorTrace Suite User Manual* for details on how to calibrate oxygen optodes.

13 Troubleshooting

13.1 Problems logging over long periods of time

13.1.1 Windows Update

Microsoft Windows Update may interfere with logging for longer periods of time. Windows may force installation of updates and restart the PC. This will obviously stop any logging of data in SensorTrace and interfere with your experiments.

There are two options for avoiding updates during an experiment

1. Disconnect the PC from the internet. This involves disconnecting any network cable and/or disabling Wi-Fi on the PC.
2. Delay or stop Windows updates in *Windows Update*
 - a. Windows 7: Go to *Control panel* => *System and Security* => *Windows Update* => *Change Settings*. Select *Never check for updates* in the dropdown menu.
 - b. Windows 10: It is not possible to stop updates, only to delay them, and only up to 35 days. Go to *Settings* => *Updates & Security* => *Windows Update* => *Advanced Options* and turn on the *Pause updates*. Windows will now show the duration of the pause.

Updates are important for keeping Windows secure. Therefore, if you choose to disable or delay updates, make sure to allow Windows to check for updates now and then.

13.1.2 Loss of connection to the UniAmp because of USB power saving

Windows may turn USB connections off in order to save power. To avoid this, open *Device manager*, double click the *Ports (COM & LPT)* to unfold it, double click *UniAmp* to open the *UniAmp Properties* window (Figure 7). Make sure that the checkbox *Allow the computer to turn off this device to save power* is unchecked.

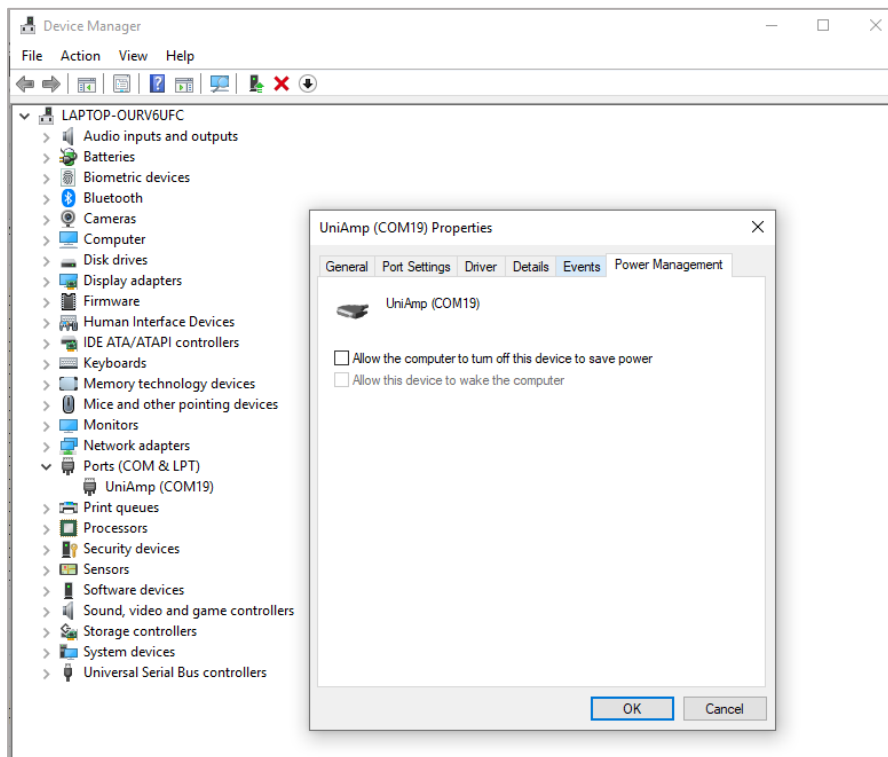


Figure 7: Power management of the USB connection to the UniAmp.

13.1.3 Disable power saving on the PC

Make sure that the PC is powered from a stable mains outlet and that it is not running on battery. In the power saving settings on your PC, disable all power saving options. Please note that it may be necessary to disable power saving options both in *Windows settings* as well as in any proprietary power management software on the PC.

13.2 Electrical noise

If the signal is noisy, it may be caused by electrical interference. This may be solved by ensuring proper grounding of the whole measuring setup:

- The cable between the mains supply and the power supply of the PC must be grounded
- The mains supply must be properly grounded
- Connect the ground connector of the UniAmp to the liquid where the sensor is measuring, using the grounding cable that came with the UniAmp. Connect the grounding cable banana plug to the connector on the back side of the UniAmp (Figure 5) and dip the other end into the liquid where the sensor is measuring (see also 8.2 *Grounding*)

In some cases, electrical noise is emitted from other equipment in the vicinity (constant temperature bath, air conditioning, oven etc.). Interference of this type will often be periodic, e.g. noise emitted when equipment is switching on or off. If such problems occur, try switching nearby equipment off one by one, to identify which equipment is generating the noise.

Alternatively, move the setup temporarily to another location, e.g. an office, and test the equipment here to see if noise problems have changed.