Quick Start Guide

QG000121

miniLiquid

Color and Turbidity in Liquids

AS726xx and AS73xx Application

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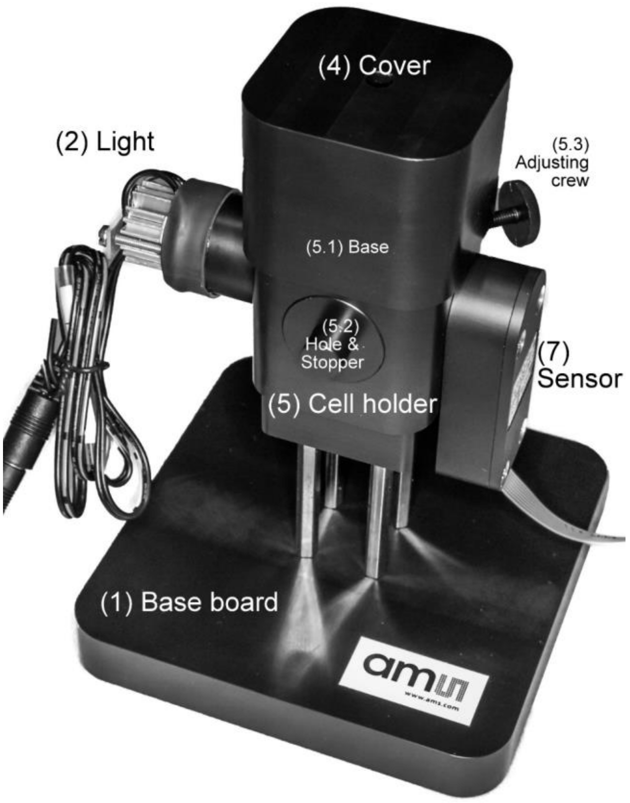
Content Guide

1 Basics

The miniLiquid DK is a special mechanical add-one system for AS7xxx compatible Demo Kits as application specific sensor system for liquid measurement. It consists of four parts mainly, which require preparing the complete mechanical setup. The sensor system includes an **ams** AS7xxx sensor chip (alternative sensor also possible on request) which must be compatible to be fixed at miniLiquid via mechanical adapter. The standard external LED light source can be mounted easily in the main miniLiquid setup, which is included in the box. The most important criterion is to choice the perfect Cuvettes that helps to analyze liquid behavior. Some tips are given within this documentation but please note, the selection of the cuvettes must be part of the customized specification because the cuvette is part of the probes.

Figure 1 :
Complete miniLiquid with Sensor and LED Based Luminary



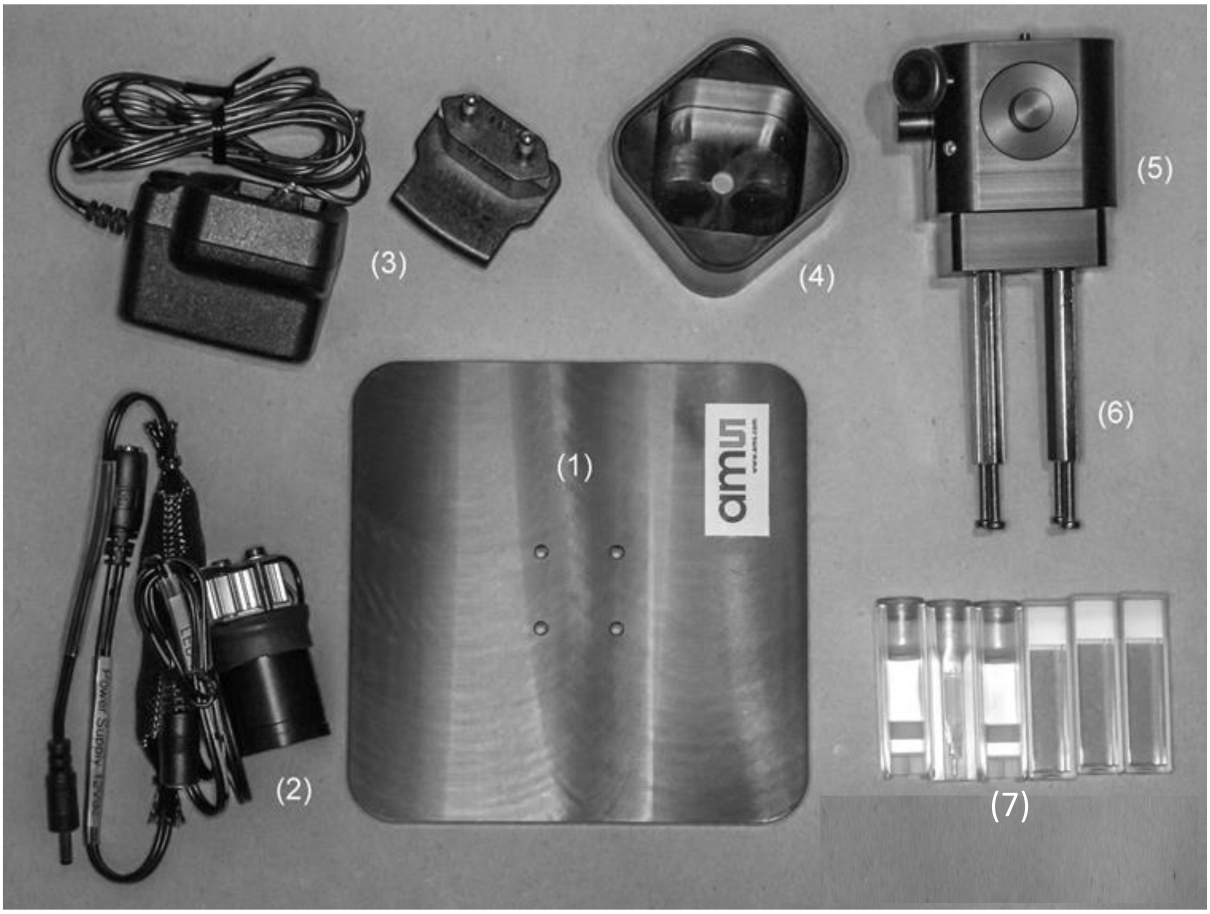
To get the optical property of liquid, this miniLiquid setup is quite suitable. Based on the measurement method, miniLiquid complete module is very stable. But note, all components of the modules represent a demonstration to show typical results for such measurements.

In this document, some typical aspects are described based on an AS7261 test kits to show the details, the setup.

2 Out of Box

The main components in the miniLiquid box as standard delivery are:

Figure 2 :
LED and Cell Holder Parts



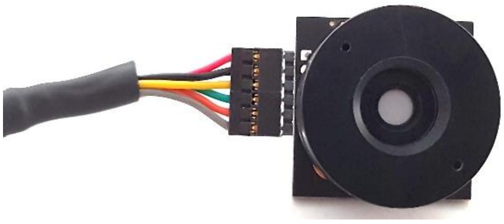
1 Base board
2 Light Source(s) VIS (+NIR) or custom specific alternatives
3 Power supply for light sources
4 Cover
5 Cell holder
6 Spacer
7 Cuvettes – examples

Please check if you have received all components before installation. Note, the sensor and/or test system must be ordered separately. Ask for miniLiquid compatible **ams** sensor systems (see chapter 3) as well as for custom specific adaptions.

3 Sensor Board(s) and/or Test Systems

The AS7261 sensor board (part of the AS726x family) is used as standard for the demo because the sensor combines XYZ filters (based on CIE1931 standard), a clear filter (CMOS sensitivity) and a width banded NIR channel.

Figure 3:
AS7261 Demo Kit (specific variant) with Optical Adapter, Diffuser and Connected FTDI Adapter



Note, other sensor test system are also possible if they can be adapted to the mechanical interfaces of miniLiquid. See the following table for compatible sensor systems and/or chapter 6 for the opto-mechanical interfaces.

Figure 4:
miniLiquid Compatible ams Test System

Type	Response
AS73210-AS89010-AB4 SET DK	True Color
AS73210-AS89010-C3 SET DK	True Color
AS73211-AB5 SET DK	True Color
AS7261 Demo Kit	True Color + NIR + Clear
AS7262 Demo Kit	6 Banded VIS
AS7263 Demo Kit	6 Banded NIR
AS7264N Demo Kit	True Color + Blue* + NIR

Please see in the data sheets and manuals for more technical details of the sensor test systems.

4 Optical Adapters

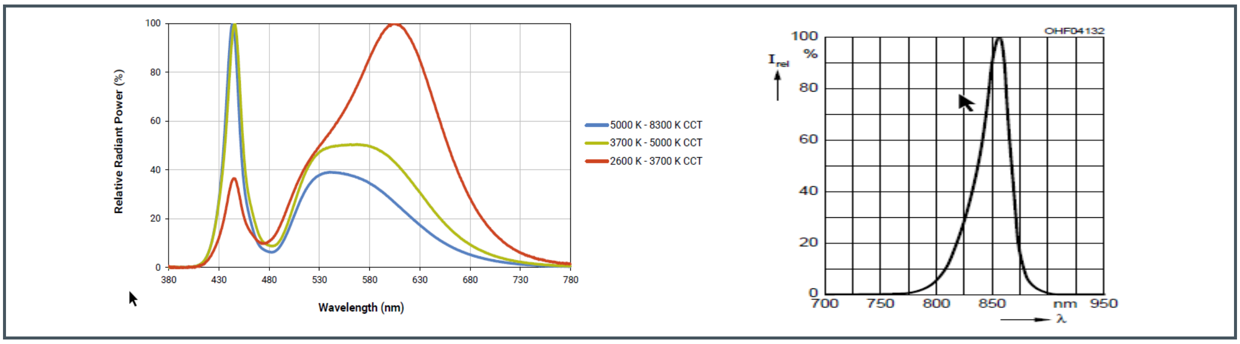
The sensor test system and the illumination must be mounted to the mechanical miniLiquid systems in the prepared mechanical interfaces (1/4”) to be fix, stable and in the correct optical path. The cell holder contains alternative mechanical openings (here named as hole) in which compatible sensors (and luminaries) with/without adapters can be inserted/mounted and fixed by screws. The alternative holes (alternative on each side of the holder) are prepared to realize alternative optical paths (90°, 180°).

Figure 5:
Alternative Adapters to Realize the 1/4" Interface Standard

5 Illuminations

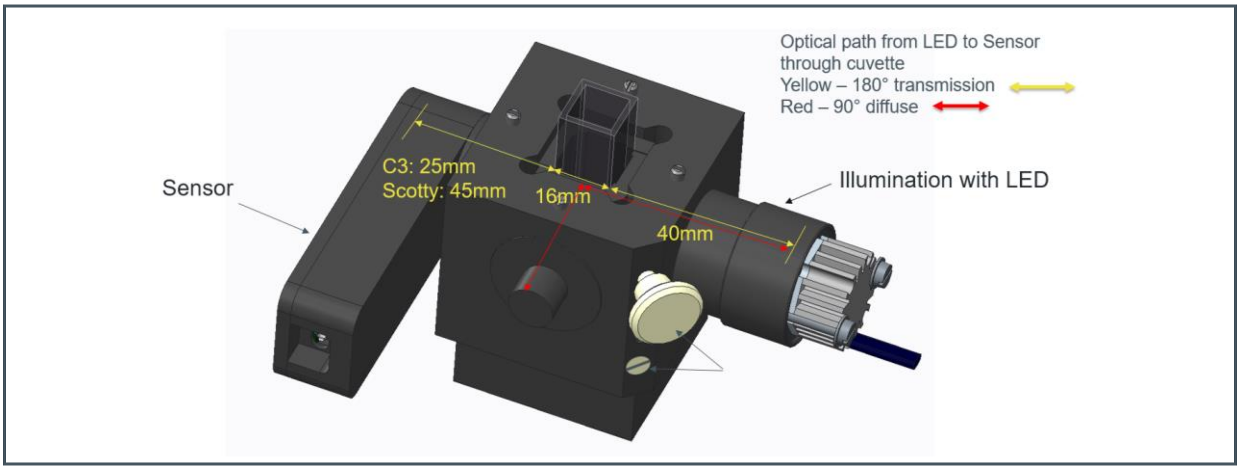
Two standard LED based luminaries are prepared to be used as White Light Source (VIS - Cree® XLamp® XM-L2 LEDs 4k CCT) and NIR LED source (SFH 4715AS). The LEDs are mounted in a mechanical housing, which can be fixed in the miniLiquid cell holder.

Figure 6:
Spectral Curves of the Standard LEDs (XM-L2, SFH 4715AS)



The mechanical housing for the luminary realizes the ¼” standard to mount the component in the holder, protect the LED and realize the correct optical path to the sensor.

Figure 7:
Standard LED Luminary in Holder and Alternative Optical Paths



In case of alternative wavelengths are needed then the LED type can be changed in the standard ¼” compatible LED housing. Alternative external luminaries in connection with a light guide and ¼” adapter can be used to realize the illumination. Ask **ams** support team for an application specific solution. Further, customized solutions are possible. Make sure the optical path from the light source to the sensor is correct and the illumination is fixed and free of interferences.

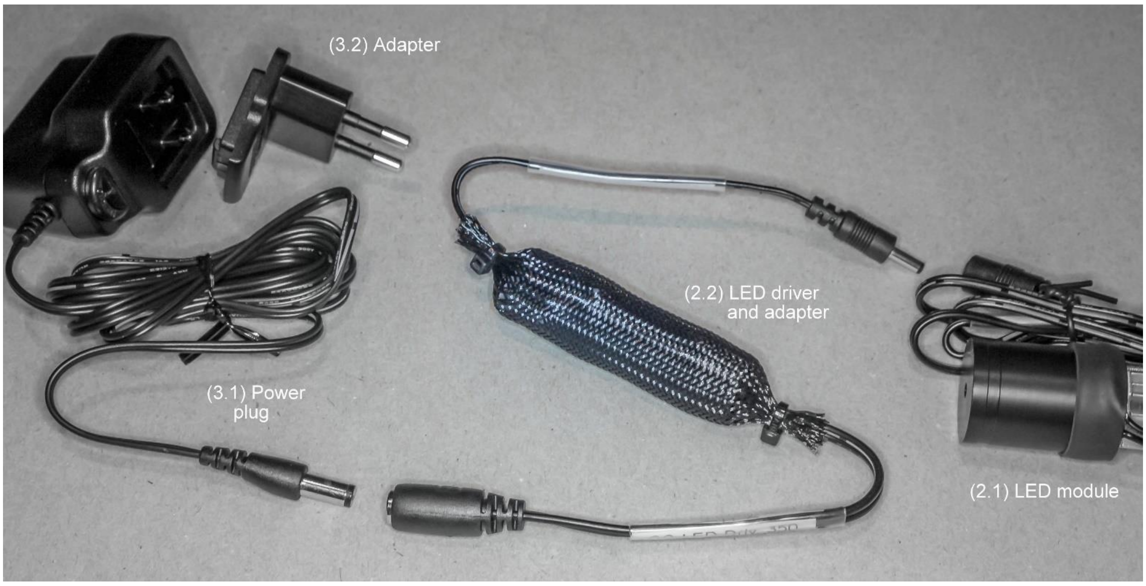
6 How to Build the Setup

To build the miniLiquid setup, the following below steps must be done:

6.1 Standard Light Source with Power Supply

- Complete the power plug (3.1) with country specific adapter (3.2) (for example)
- Connect the power plug with the LED driver and adapter (2.2) to the LED module (2.1)
- Mount the complete light source into one free hole of the cell holder and fix it

Figure 8 :
Power Supply

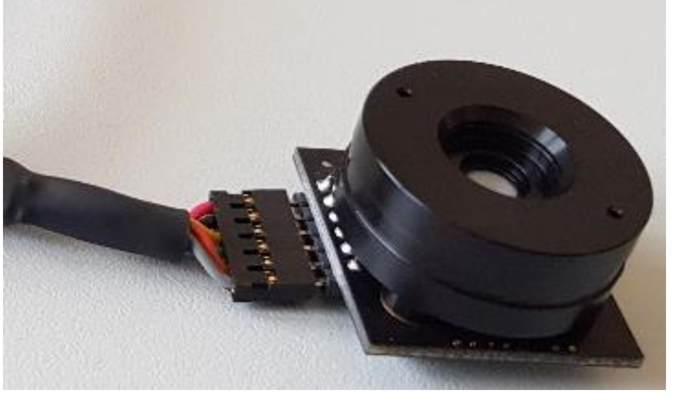


6.2 Sensor

Here shown at the example AS7261 2Vx hardware version with ¼” adapter. Single sensors must be assembled, other sensors are ready to use.

- Mount the Optical adapter and diffuser top of the Sensor and tide up with two screws.
- Connect the FTDI cable to the connecting slot in the sensor board (9). Pin 1 (the pin with square pad) needs to be connected to RED wire of the cable. USB end of FTDI cable is connected to PC. MiniLiquid and its software is designed I2C and UART communication interface. On standard I²C communication is required.

Figure 9 :
Diffuser is Mounted Top of the Sensor and Connected FTDI Cable



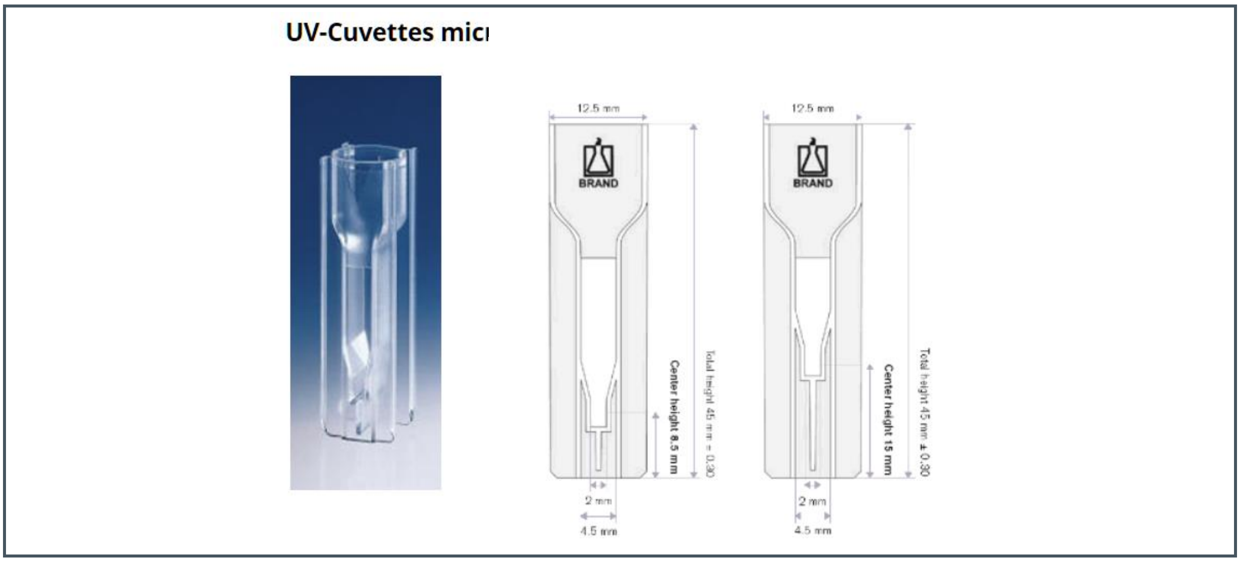
6.3 Assemble the miniLiquid

- Plug the cell holder (5) with mounted spacer (6) in the base board (1) and screw it on the back side of the base board.
- Install the assembled light source (2) into the cell holder (5) by using one of the free holes (5.2) in the holder. If necessary, remove the stopper before. It is important to fix the stopper, illuminator and sensors. Therefore, those can be fixed with a screw on the top of the holder.
- Install the sensor (9) in a second free hole. It is important to note that the optical path selection is depending on the required method (180° transmission or 90° diffuse).

6.4 Cuvettes

- Use the delivered (Macro/Semi-Micro) cuvettes (7) or similar. In case of sensor sensitivity, problems in combination with dark liquids use the semi-micro cuvettes to increase the light energy on the sensor by a smaller optical path through the liquid.
- Insert the cuvette into the holder (hole in the top side). If necessary, fix the holding part inside of the holder with the white screw on the vertical side of the holder. It will fix the cuvette in the holder. Check the optical path. If the cuvette contains liquids, the liquid must be filled almost to the top.
- Cover the cuvette in the holder to prevent ambient lighting.

Figure 10:
Cuvettes



(https://www.brand.de/en/products/life-science-products/cuvettes-and-accessories/uv-cuvettes/)

7 Software Installation

The software and drivers of the ordered sensor test system must be installed on the PC after the mechanical SETUP realization is completed. Please check the sensor manuals for more details.

8 Start-Up MiniLiquid

- Check the assembly of all mechanical parts, light source and sensor. Plug in the cuvette with the probe. Seal the holder by using the cover. Connect the light source to power supply and the sensor via USB to the PC. Switch on all and wait 30 minutes to get working temperature.
- To get a stable test system, use one sample from the test series for the next partial step. Select the parameters in the test software (select gain and integration time) and start the measurement in such a way that stable values as sensor result greater than 10,000 digits and more are achieved. Measure over a period and optimize the test system by excluding interfering sources until stable values are established without noise.
- Check the dynamic of the selected parameters with the darkest (e.g. 100% concentration) and lightest (0% concentration) probe. If the selected parameters are not able to measure the full target then use a dynamic gain. In this case, check the linearity of the sensor conversion parameters before and work with calculated results no-depend on these parameters (e.g. basic counts). Check also non-linearity and drifts over temperature to be able to correct the measured counts.

For more information about the sensors, please see the data sheets and/or application notes.

Figure 11 :
LED - Sensor Long-Time Test to See Stability (700 steps)

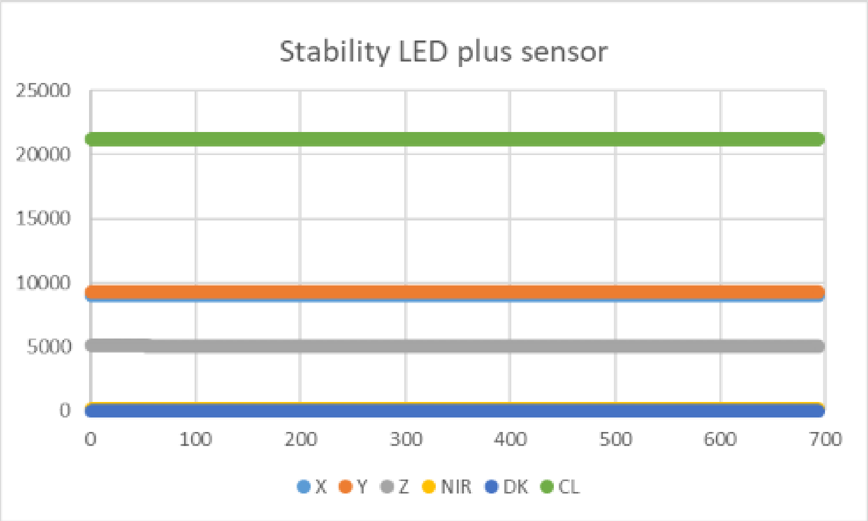


Figure 12:
Linearity Test for Integration Time (AS7261)

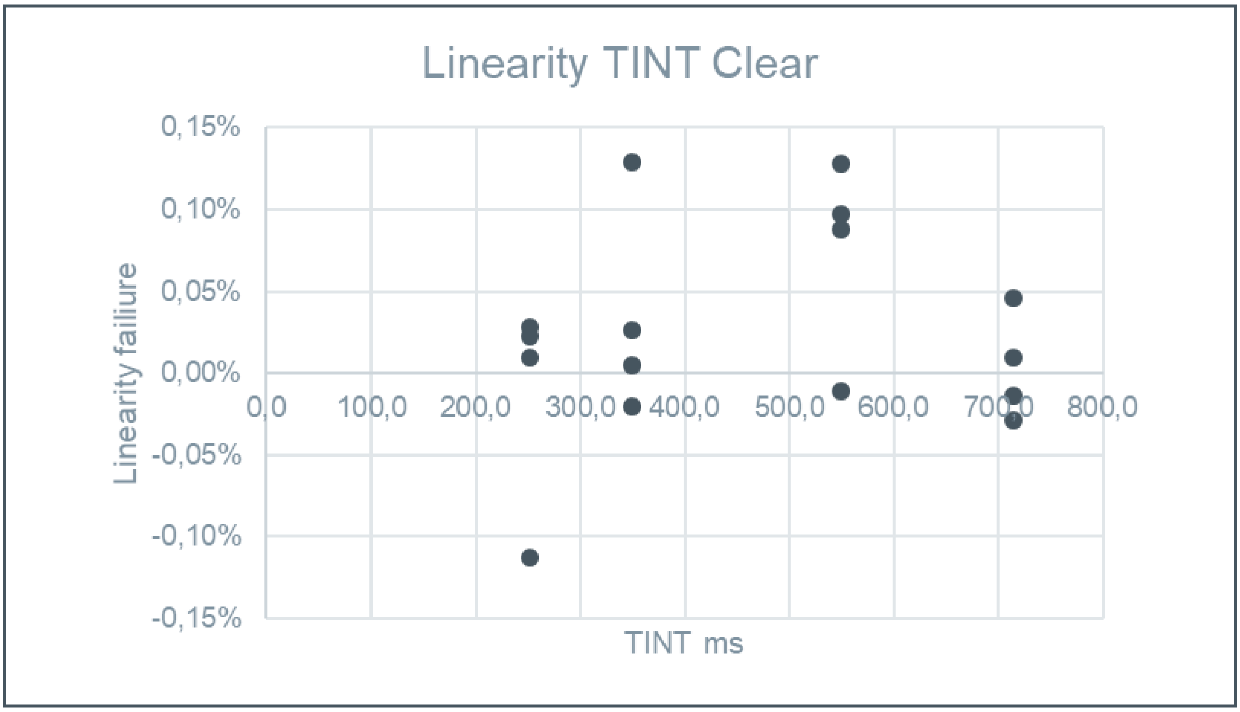


Figure 13 :
Gain Error Between 1…64 (AS7261)

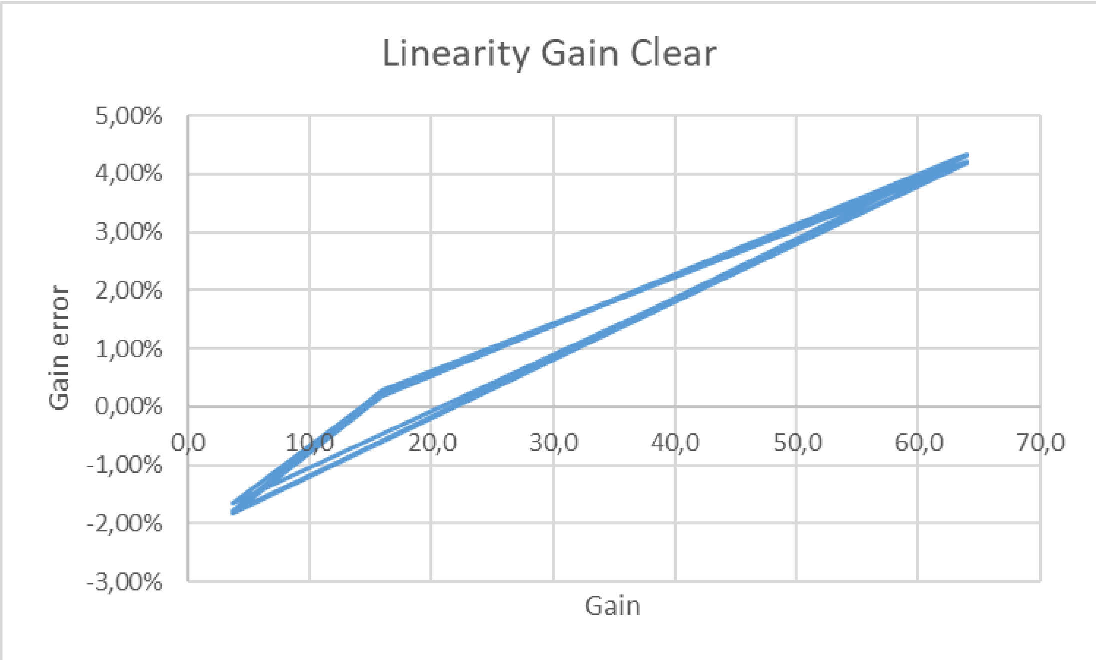
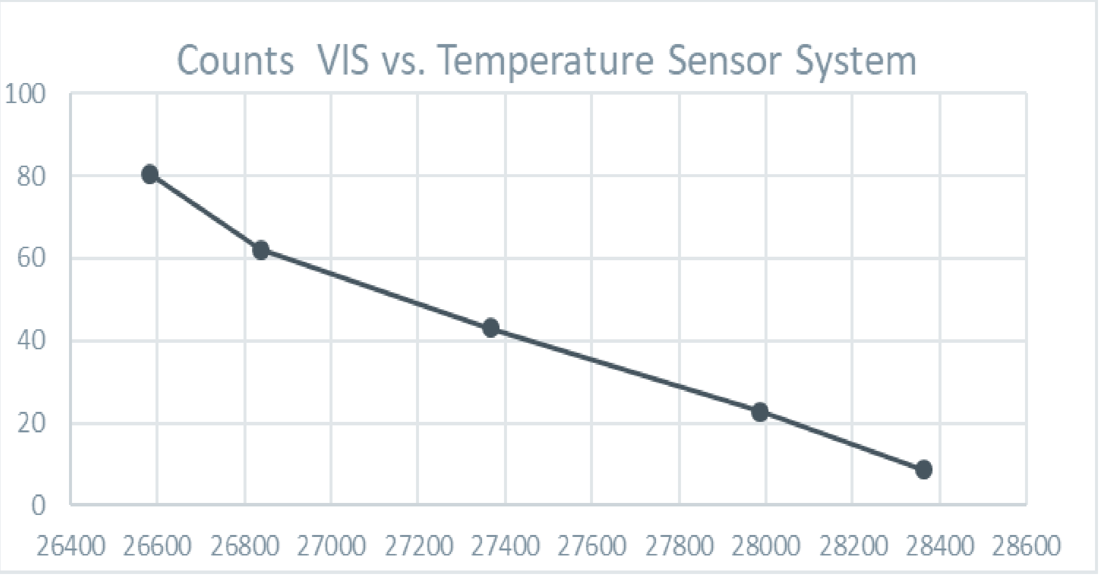


Figure 14 :
Temperature Curve (AS7261+White Light LED)

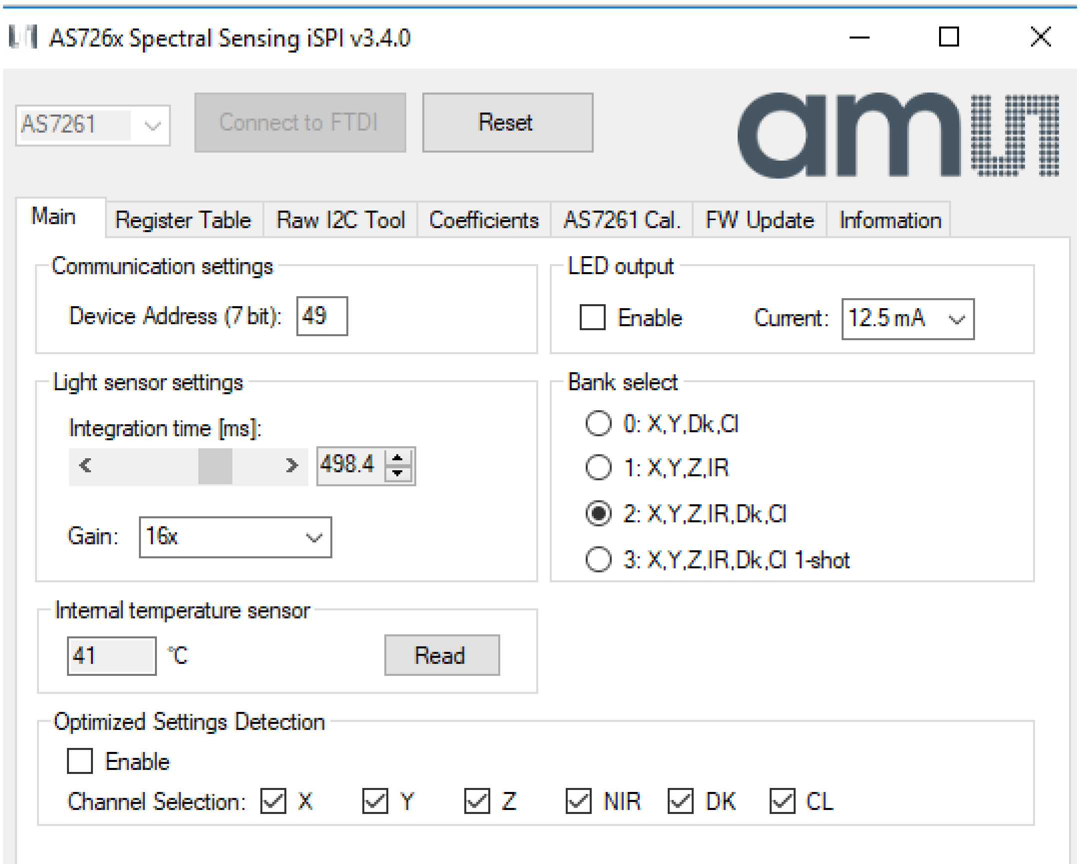


9 First Test with AS7261

9.1 'Fixed Setup'

The following is based on a connected miniLiquid plus white light source (standard white light source) without fluidic probe in the cuvette and running test system AS7261 with the setup shown in the following figure.

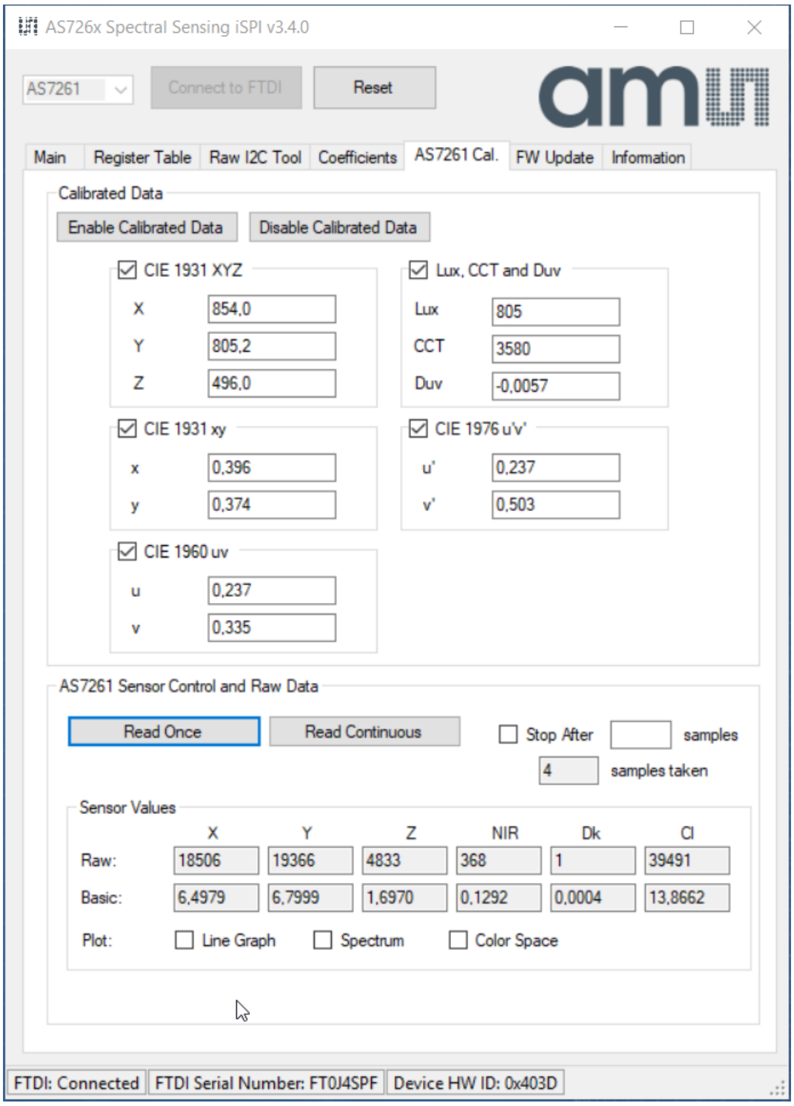
Figure 15 :
Main Window First Step - Select TINT=498.4ms, Gain=16



Go to the window 'AS7261 Cal' and press button 'ReadOnce'. You should get nearly the following results (see sensor results in Figure 16). Differences between the presented results here and results with another miniLiquid system are plausible because the variation for example of the white light LEDs can be up to 100% for brightness, connected with spectral shifts. Other reasons could be differences in the probes, cuvettes, etc.. Therefore, use these results here only as typical trend to understand the method and affects.

Based on the parameter setup, the raw counts for XYZ are in the upper regions of FSR, NIR and Dark filters have a low response because a white LED is used.

Figure 16 :
Read and Compare the Results[1]



[1] The results in the "Calibrated Data' are only applicable if the sensor system was calibrated based on CIE1931 conditions and the application is CIE1931 True Color Measurement. The software cannot check whether these conditions are valid. It is recommended to use this result block 'Calibrated data" only if the conditions are valid and to use the results.

9.2 'Optimized'

Go back to the Main window and switch on 'Optimized Settings Detection'. Now the software enable the automatic algorithm for 'dynamic gain'. Make the new 'Read Once' and compare the settings in the 'Main windows' and the sensor results in the 'AS7261 Cal'. The results should be similar.

Figure 17 :
Enable Optimized Settings Detection (with the optimized setup here)

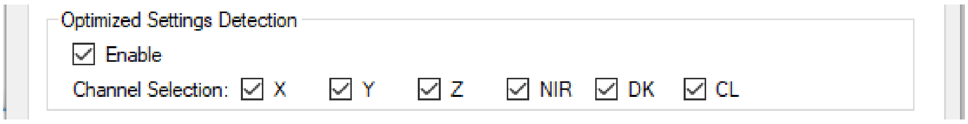
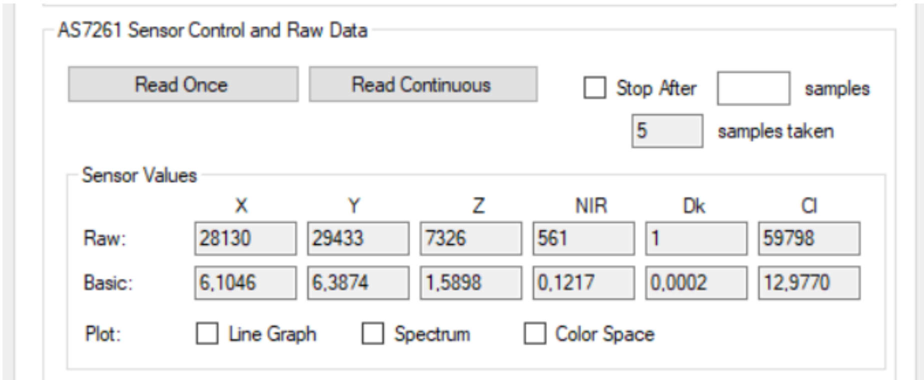
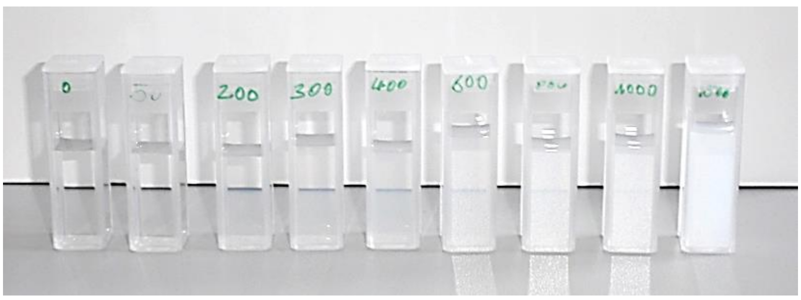


Figure 18 :
Sensor Result (typical) for Optimized Settings Detection



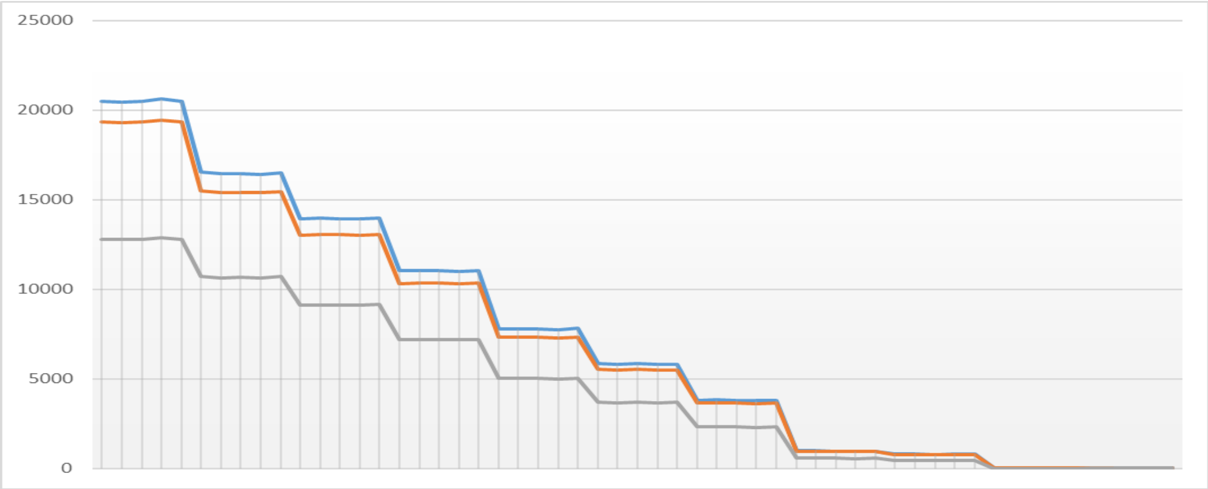
Prepare in some cuvettes alternative probes (e.g. mix from water and milk by doubling the volumes of one part to achieve a 50% probe) and measure all probes with alternative concentrations (100%, 50%, 25%, 12.5%….).

Figure 19 :
Alternative Probes (mixed from a turbidity standard)



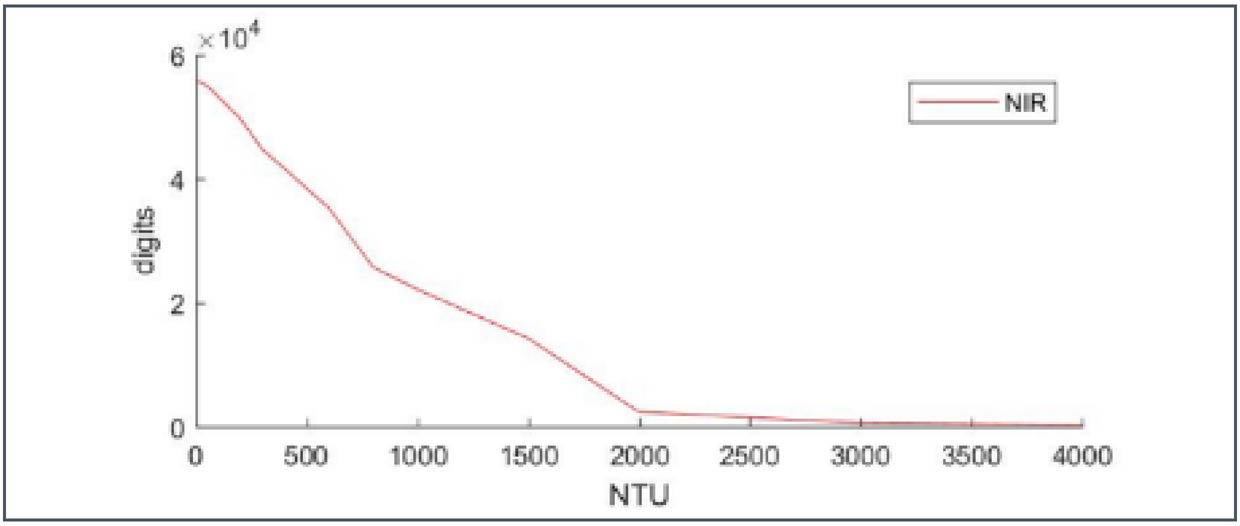
Measure by using one parameters setup or by using dynamic gain to get the counts for X Y Z NIR Dk Cl. Open a log (protocol file) to have the results in a CSV file then measure the probes. Close the log file and prepare a diagram from the measured counts.

Figure 20 :
Results in Counts from the Probes in Alternative Concentrations (VIS combination)



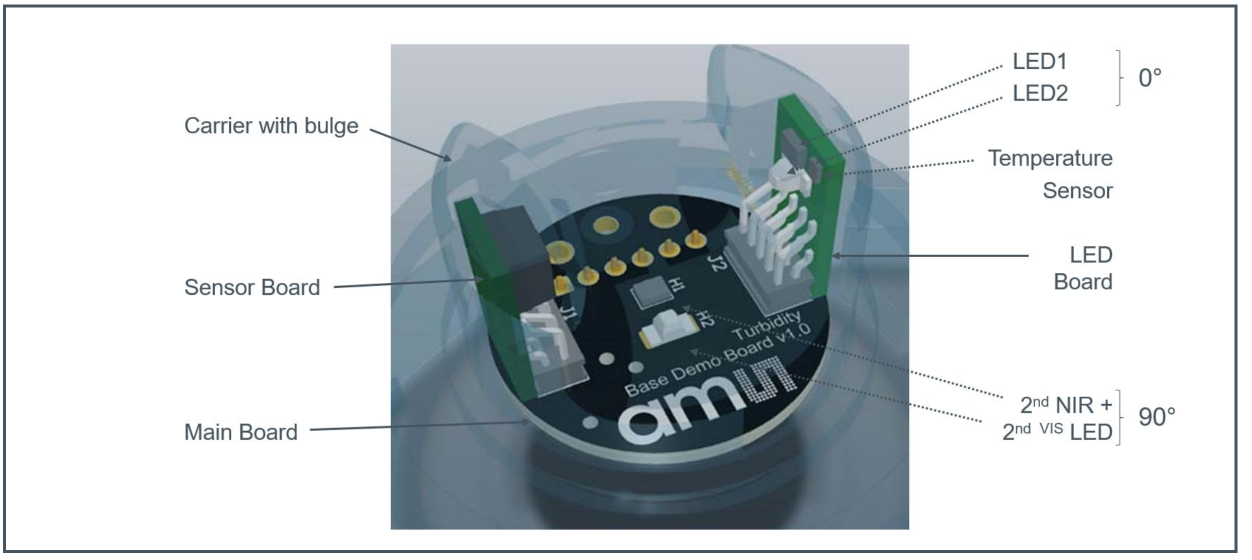
Measure on the same way these probes by using NIR LED and NIR Channel and the results will be different but similar.

Figure 21:
Results in Counts from the Probes in Alternative Concentrations (NIR combination



Compare the results with the planned target accuracy after measuring of all required concentrations. Then the next step will be to make a sensor prototype near test system, like the **ams** AquaSensor. With such a sensor, more tests under real application based conditions are possible as well as series tests and variations can be done.

Figure 22:
ams Liquid Test System AquaSensor



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