

**SENSOR SYSTEM FOR AN AUTOMATED  
HYDROMETEOROLOGICAL / ENVIRONMENTAL STATION IN  
THEOREMS-DNIPRO INTERNATIONAL PROJECT**

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Since June 13, 2002, the Agreement between the Government of the Republic of Belarus and the Cabinet of Ministers of Ukraine on the joint use and protection of transboundary waters is valid. In order to implement the Agreement following working groups have been established: the working group on the exploitation of the Belaazjorsk water supply system of the Dnipro-Bug Canal; the working group on joint use of water resources, engineering, construction and operation of water facilities; working group on the protection and control of water quality; the working group on hydrometeorology. One of the steps in developing a network of automated hydrometeorological observations on both sides of the border and increasing of relevant interstate interaction is the project “THEOREMS-Dnipro. Transboundary Hydrometeorological and Environmental Monitoring System of Dnipro river” implemented through the First Territorial Cooperation Program for the Eastern Partnership Countries “Belarus – Ukraine” funded by the European Union.

As part of the project it is planned to create two unified automated hydrometeorological / ecological stations in the area of long-term hydrometeorological observations (in Belarus – gauging station “Loew”, in Ukraine – gauging station “Lubech”).

Structurally, the hydrometeorological and ecological station AHMES consists of a data acquisition module, a required set of sensors, an information transfer module, and a power supply module. Figure 1 shows the structural diagram of AHMES measuring station.

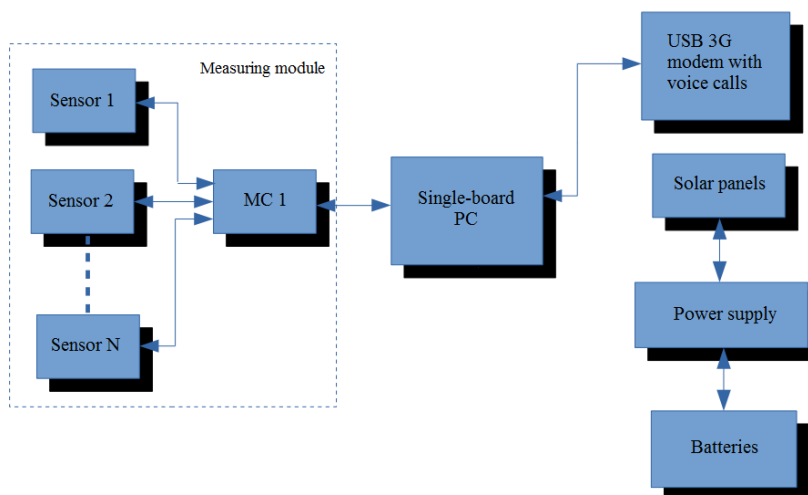


Fig. 1. Structural diagram of AHMES measuring station

In the construction of hydro-meteorological and environmental AHMES station is planned to realize the measurement of the following parameters:

- hydrology: water level and temperature;
- weather: air temperature and humidity, atmospheric pressure, wind speed and direction, rainfall;
- environmental: pH, dissolved oxygen, specific conductance, chloride ions, sulfate ions.

To measure the *water level* preference is given to the hydrostatic probe (Keller PAA-36 X W). Estimated measuring range 0–20 m (0,002 % resolution), 4–20 mA, integrated 16 bit ADC [1].

For reliable and accurate measurements of *water temperature* it is required the sensor (for example, Vaisala QMT110) with the measuring range of  $-60...+60$  °C and accuracy of at least 0,08 °C with analog or digital output, watertight in range of 0,1–4 bar [2].

For measurement of *ecological parameters* may be used a complex sensor (s::scan ISE Sonde V21), which can measure depending on the device variant:

- ammonium ( $\text{NH}_4\text{-N}$ )  $\pm 3$  %;
- potassium (K)  $\pm 3$  %;
- nitrate ( $\text{NO}_3$ )  $\pm 3$  %;
- fluor (F)  $\pm 3$  %;
- temperature (T) ( $0...+60$  °C  $\pm 0,1$  °C);
- pH ( $2...12$  pH  $\pm 0,01$  pH).

Operating pressure 14,5–87 psi, IP68, response time 60 sec, power supply 10–15 VDC.

For reliable and accurate measurement of *air temperature, atmosphere pressure and humidity* it is required the sensor (for example, Vaisala WXT534) with the digital output (RS485 interface), operating voltage 6–24 VDC, and the measuring ranges of:

- temperature:  $-52...+60$  °C and accuracy of at least 0,3 °C;
- atmosphere pressure: 500–1100 hPa (375–825 mm Hg);
- humidity: 0–100 % and accuracy of not less than 2 % [3].

To measure *wind speed and direction* it is required compact size combined into one unit wind speed and direction sensor (for example, Vaisala WXT532), with the possibility of heating for work in the cold season, response time is 0,25 s, operating voltage 6...24 VDC.

- wind speed measurement range 0...60 m/s  $\pm$  3 % at 10 m/s;
- wind direction measurement 0...360°  $\pm$  3° at 10 m/s [3].

To measure the *amount of precipitation* is expected to use a recording rain gauge (OTT Pluvio<sup>2</sup>) with a tipping bucket, operating voltage 10 ... 28 VDC, measuring range up to 400 cm<sup>2</sup>  $\pm$  0.05 mm, RS485 or SDI-12 interfaces, intensity output interval – 1 minute.

To collect data from sensors and data transmission via GSM-module Neoway n720 demo-board, powered by 5V/2A adaptor, 2G/3G/4G antenna interfaces, 3,3V LDO voltage regulator, USB interface, SIM card interface.

In order to use renewable energy sources, the AHMES station will be powered by a 36 W rechargeable battery recharging by a solar panel (LP-270P) – 270 W, 32 V, 8,64 A.

The data of the main meteorological values will be recorder every 10-minute intervals, which end at 21, 00, 03, 06, 09, 12, 15, 18 h UTC.

### Conclusion

1. As a result of this part of the project a set of required sensors for the AHMES automated hydrometeorological / environmental monitoring stations has been selected and tested.

2. The implementation of this part of the project has allowed to estimate required parameters of the sensors selected, ensure that they meet all established criteria, including measurement ranges, reliability and cost.



The project is co-funded  
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### List of sources used

1. Highly Precise Level Transmitters Keller Series PAA-36 X W. User manual and specifications.
2. Soil/Water Temperature Probe Vaisala QMT110. Main features, specifications and technical data.
3. Vaisala Weather Transmitter WXT530 Series. User manual and technical information.