Precision differential *pH* meter for long-term monitoring of liquids

The device is intended for single-ended or differential *pH* measurement with high accuracy and high resolution. Due to ultra-low-noise electronic components and precision measuring capabilities, the instrument is able to measure differential acid-base changes in the test fluids at 10^{-5}-10^{-7} *pH* level that is not possible for most of other devices. Main applications are long-term laboratory and field measurements of small and ultra-small *pH* changes.

This device features a capability of long-term autonomous operations (up to 60 days) without a computer or human intervention. The main settings are performed via USB interface using the client software on a PC. The *pH* meter has a 32-bit ARM microcontroller with up to 67 MHz clock frequency, 20-24 bit ADC and 64 Mb of non-volatile flash memory. Data from embedded sensors that characterize environmental parameters – 3D magnetometer, 3D accelerometer, 4-channel temperature logger (two precision sensors LM35 supplied) and voltage supply – are recorded together with the *pH* measurement data. There are I2C, SPI, CAN, UART, USB interfaces for connecting additional sensors. All data are recorded in real time with time stamps. For precise *pH* measurements the device has a built-in two-channel thermostat with the PID controller, which allows keeping the temperature setpoint with the accuracy of <0.01°C. The device is powered from the USB interface and/or USB battery (PowerBank). There are 2 miniUSB connectors for power supply and the PC interface, D-Sub-9 connector for 4x temperature sensors and 2x resistive heating elements for thermostats (thermostat containers are included into the package), 2x BNC connectors for *pH* electrodes (electrodes are included into the package).

Features

- number of *pH* channels 2
- number of temperature channels 4
- range of *pH* measurements 0-14(4-10)
- resolution of measurement channel:
  - for 0-14*pH* 61nV (~10^{-6} *pH*)
  - for 4-10*pH* 30nV (~5 ·10^{-7} *pH*)
- level of noise[1] <1µV
- sampling frequency[2] 0.1sec-1hour
- resolution of temperature sensors[3] ±0.002°C
- non-volatile (flash) memory 64 Mb
- consumed current[4] 5-50mA
- autonomous operation with USB PowerBank, 9A/h >70 days
- size 105x70x19mm
- weight 130g

Applications

- precision biochemical measurements
- long-term monitoring of environmental parameters
- long-term monitoring of *pH* in various liquids
- monitoring of water quality

The device also has applications in areas related to detecting weak und ultra-weak impact factors, e.g. in homeopathy, information pharmacology, information imprinting, “non-electromagnetic”/"high-penetrating" impacts, see the Application Note AN-CR25 “Applications of precision *pH* measurements”.

[1]Test conditions: battery power supply, all interfaces are off, MCU clock frequency 6Mhz, the device is operated in laboratory with a low level of environmental EM noise.
[2]Minimal/maximal sampling rate is determined by the number of measured parameters, the clock frequency and ADC resolution.
[3]This resolution is primarily defined by electronic noise, data are shown for the LM35 precision sensor when measuring a relative temperature.
[4] It depends on the MCU clock frequency, number of connected sensors and the thermostat’s operating mode.

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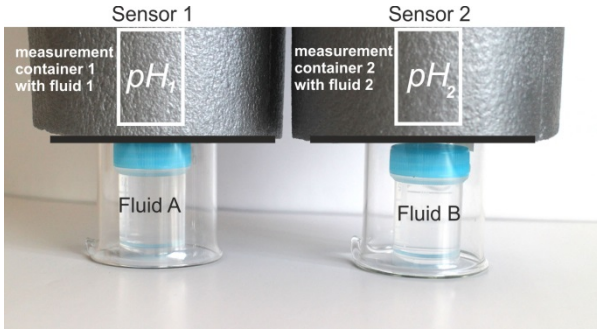
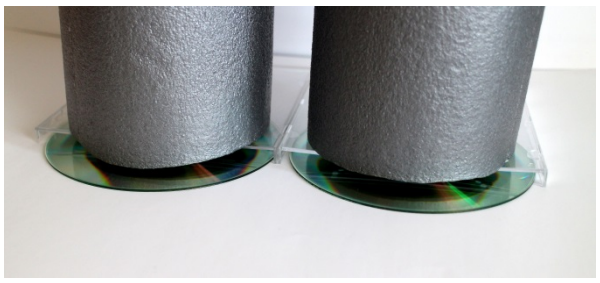
Application of precision differential *pH*-meter for detecting weak and ultra-weak impact factors in geo-biological areas, homeopathy and information pharmacology

High accuracy of measuring the acid-base difference of two liquids allows detecting and charactering weak and ultra-weak impact factors[1]. Typically, these impact factors are associated with geobiological effects (so-called geopathogenic zones), various modulators/harmonizers, information imprinting, information pharmacology and homeopathic methods. Despite controversial discussion in various academic communities, effects of these techniques can be detected in many cases by physical instruments and laboratory biochemical methods. Precision differential *pH* measurements belong to such physical instrumental methods.

The measurement methodology is following. Two identical objects, for example, two containers with a liquid filled from one source but differently handled, have different impact on the sensors. The figure shows two such liquids: the liquid A and the liquid B, which are placed under the sensors 1 and 2. The *pH* sensors have two identical test fluids 1 and 2 (typically, distilled water or organic solvents), whose *pH* values are measured during several hours. The liquids A and B originate from the same source, however they can be stored in different places (to detect the impact of geobiological factors) or subjected to various imprinting approaches (information pharmacology and homeopathy) or handled in other ways. Dynamics of *pH* changes, shown in the figure below, demonstrates two clearly distinct empty and impact areas. The sign and declination of curves provide information about the type of impact and its intensity. Without impact factors the dynamics of *pH* shows a monotonic behavior without any anomalies[2].





Instead of liquids, various solid objects, such as activated CD[3] or information modulators, can be used. Together with *pH* values the system records up to 32 other data, including the intensity of magnetic field, mechanical stress, the temperature in several places, supply voltage, etc. All these data allow characterizing more accurately the impact of these weak and ultra-weak factors in further analysis.

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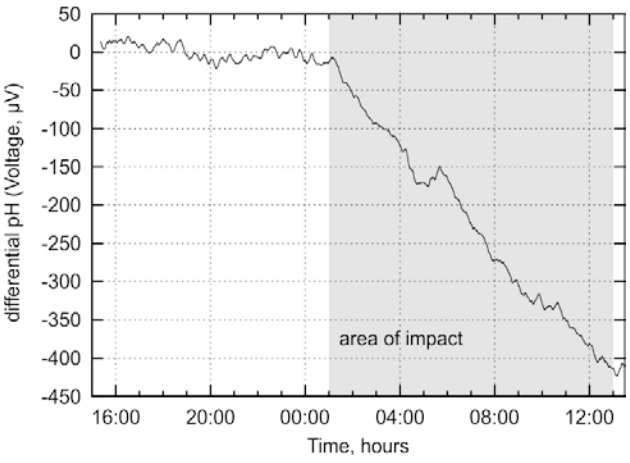

[1] Precision differential pH meter has two pending international patents, the methodology of detecting weak and ultra-weak impact factors with precision *pH* measurement is published and cannot be patented anymore.

[2] see the Application Note AN-CR25 “Applications of precision *pH* measurements”.

[3] Technology of CD activation is a patented technology of IC Medicals®.