State of Charge sensor and State of Charge display

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Task

The task is to control continuously for a long time the „State of Charge“ (SOC) in lead acid batteries.

The SOC of lead acid batteries is directly coupled with the acid density. More precisely the SOC is a function of the acid concentration respectively acid activity.

Unfortunately the acid activity is not homogeneous inside of the battery due to the stratification.

Especially above the plates you will find large differences until the gas formation during overcharging.

Solution

The sensitive part of the sensor is a 30mm long thread at the lower end of the sensor. The thread is inside of a 3mm or 4mm diameter, corrosion resistant high alloy steel tube.

With changes of the acid concentration the thread reacts with changes of its length; similar to an old fashioned hygrometer. This motion is detected by a displacement transducer at the top of the sensor (white element behind the round shaped magnet of the flat spring).

In order to avoid short cuts, the tube is covered by a heat shrink tube.

A gas tight separator at the end of tube tubes enable the uptake of acid, but not the permeation of gas bubbles, which might develop during over charging.

Operation

Connect the display unit with the power supply (9Volt DC). Connect the sensor with the display unit (5V DC) with the right polarity (visual through the acrylic glass)
Store the sensor for 24h in a sulfuric acid with a known density. After that the sensor is ready for calibration

Remote control: You may read the voltage and calculated acid density from the display unit from the USB serial interface (9600baud). You may also connect the sensor to your process control system, just plug in the voltage input device of your process control system to the ground and signal plugs of the sensor.
You may also drive the sensor with a power supply of your process control. If the power supply is different to 5V you have to keep in mind that the sensor signal depends on the supply voltage (should be in the range between 5 and 12 V DC). Then you have to calibrate the sensor in two different acid densities, if you run the sensor with a different voltage than 5 V DC (for example 1.1 und 1.3 g/cm³).

Attention: Do not clean the sensor with alcohol

Calibration

Usually you just need a 1-point calibration. Doing that you have to disclamp the counter nut at the high alloyed steel tube. Turn the high alloyed steel tube until you observe the right density value and tight the counter nut again.

Interface

You may read the sensor voltages and the calculate density values at the USB interface (9600 Baud).

Dimensions

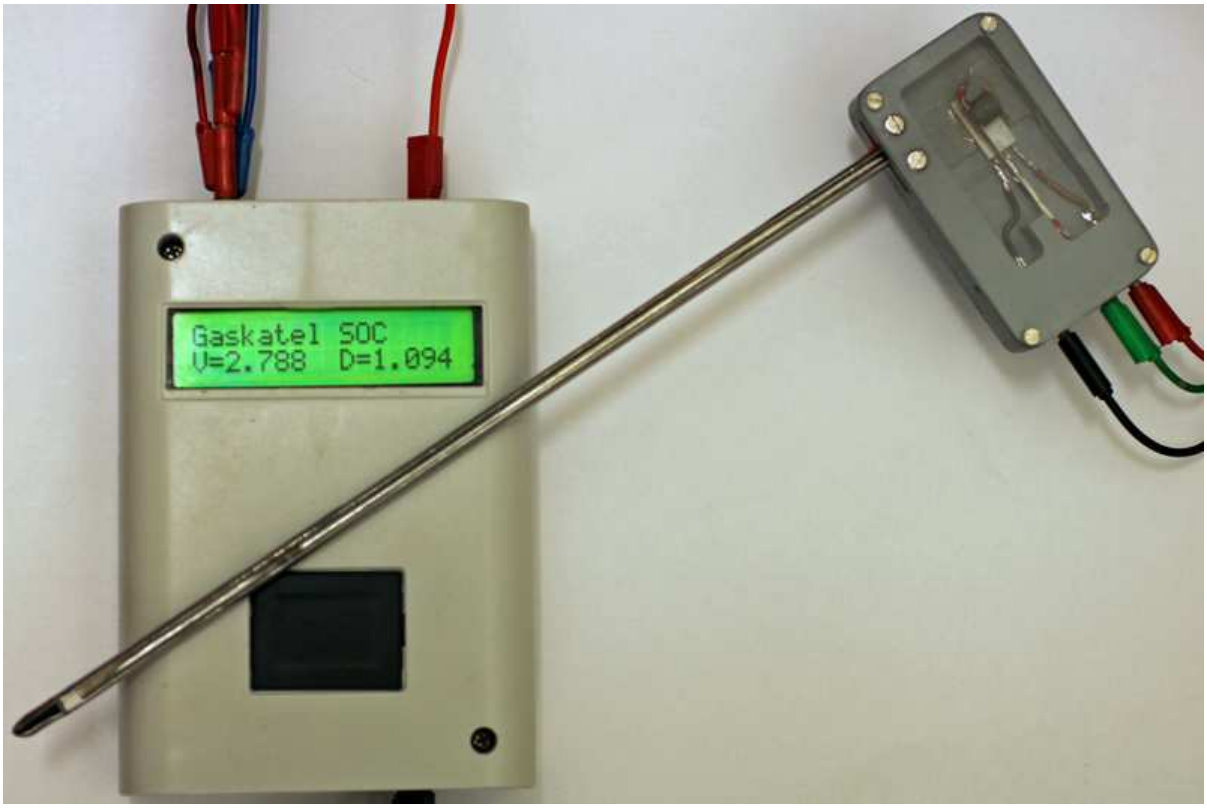
Sensor enclosure 69 x 39 x 13 mm³
Tube diameter Ø3mm or 4mm, Tube length: 50 to 700 mm, custom specific

Display Unit

Based on ATmega 328 processor.
10 bit AD Converter
16x2 Display

Measurement range and exactness

Range	**1.05** bis **1.45** g/cm³
Error	0.005 g/cm³
Time constant	10 Minutes until 95%



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