Solid State Technology
Volume: 63 Issue: 5
Publication Year: 2020

Monitoring And Measuring The Level Of Water Objects Bythe Ultrasonic Method

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Abstract: This article discusses ultrasonic sensors for level monitoring and measurement, with unified 4 ... 20 mA output current signals, with two-wire digital industrial communication interfaces such as HART, PROFIBUSSPA and Foundation Fieldbus. [1.10] The most widely used ultrasonic sensors of the LUC4 and LUC-T series and methods for installing and connecting ultrasonic sensors of the LUC-T series are presented. The principle of the implementation of the ultrasonic method for determining the water level is also presented here. This measurement method guarantees reliable operation of ultrasonic sensors in various conditions. [2.5.11]
The advantages and disadvantages of the ultrasonic measurement method are shown. To implement the method, it does not impose high requirements on the wear resistance and strength of the equipment and is independent of the density of the controlled medium. [3.12] The sensor has a built-in compensation system from the influence of temperature fluctuations on the measurement result. [4.13] Sensors of the LUC4, LUC-T series are specially designed and operate on a non-contact measurement method and measure the level of water and various liquids. [5.20]
Keywords: *ultrasonic sensors, water level, ultrasonic measurement method, non-contact method.*

I. INTRODUCTION

The management of technological processes in the water sector is related to the measurement of water level. Modern automation systems require statistical and informational data to optimize process control,increase water efficiency. This constantly increasing demand for information leads to the need to use in the monitoring systems not simple signaling devices, but means providing continuous measurement. [6] For this, new measuring instruments based on ultrasonic, electromagnetic and other methods of monitoring and measuring the level of liquids were developed and experimentally tested.
In the presented article, the main goal is to control and measure the level in water systems using ultrasonic sensors and the level measurement method. [1.7]

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II. METHODOLOGY

Devices for continuous monitoring of liquid levels are created using various physical principles and measurement methods. The considered level gauges work with unified 4 ... 20 mA current output signals, with two-wire digital industrial communication interfaces, such as HART, PROFIBUSSPA and Foundation Fieldbus, their modifications for installation in hazardous areas of class 0, as well as complete solutions based on measuring instruments, controllers, means for interfacing with a control device and additional equipment [1]
To determine the water level in water management systems, we consider the principle of operation of ultrasonic sensors and methods for measuring the level. In the simplest and most common case, when the ultrasonic sensor is located at the upper point of the tank, the medium level is calculated as the difference between the height of the tank and the distance between the sensor and the surface of the medium (in the general case, a correction should be made that takes into account the difference between the actual height of the sensor and the height of the tank) .[5.8] This distance is calculated by the measured time, which is necessary for the ultrasonic pulse to travel from the sensor to the surface of the controlled water and vice versa (Figure 1).

$$h = h_{tot} - 1/\ 2\ v_s t$$

Here "vs" is the propagation velocity of an ultrasonic signal in a given medium.

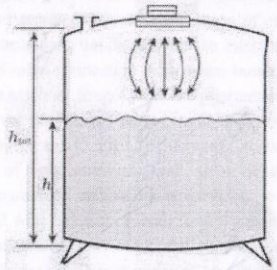

Fig. 1. The principle of implementation of the ultrasonic method for determining the level.

The chemical and physical properties of liquids do not affect the measurement result obtained by the ultrasonic testing method, so the level of both water and various liquids can be measured without problems. However, it must be remembered that the speed of propagation of ultrasound is influenced by air temperature in the medium of its propagation. [9] In addition, being strongly dependent on temperature, the speed of ultrasound depends on air pressure: it increases with increasing pressure. Relative changes in the speed of sound associated with changes in pressure in a normal atmosphere are approximately 5%. The speed of ultrasound also depends on the