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TMR DIGITAL LATCHES IN POINT-LEVEL LIQUID SENSORS

By Allegro MicroSystems

INTRODUCTION

Liquid-level sensors are used in a variety of applications in the industrial and consumer marketplace and play a vital role in providing the necessary data to the host system. Applications such as industrial storage tanks, vats for wine, refrigerators, dish washers, clothes-washer machines, coffee makers, and water coolers all require liquid-level sensors to indicate the remaining fluid level.

To implement an optimal level-monitoring method for industrial and commercial markets, many variables must be taken into consideration by the designer, including electrical (power consumption, operating voltage, accuracy response rate, noise), mechanical (tank material, tank size, appearance), chemical (phase of matter, type of liquid) environmental (operating temperature, pressure, vibration, shock), system (calibration, programming), and cost (price). Given the specifications and requirements for the liquid-level sensor, a compromise in price, performance, and size must be realized for a marketable solution.

These liquid-level sensors may be designed using a variety of sensing methodologies, such as magnetic float, mechanical float, optical interface, capacitive, and pneumatic, to name just a few. This application note focuses on the implementation of point-level sensors for liquids using magnetic float principles.

POINT-LEVEL LIQUID SENSORS

Point-level liquid sensors indicate whether the liquid is above or below the sensing point and, thus, are set up as a string of sensing points to the level of the liquid if the sensing points have been triggered.

Allegro CT8131BV TMR digital latches are excellent solutions for a point-level liquid sensor based on the magnetic float methodology. The CT8131BV high-sensitivity magnetic latches enable
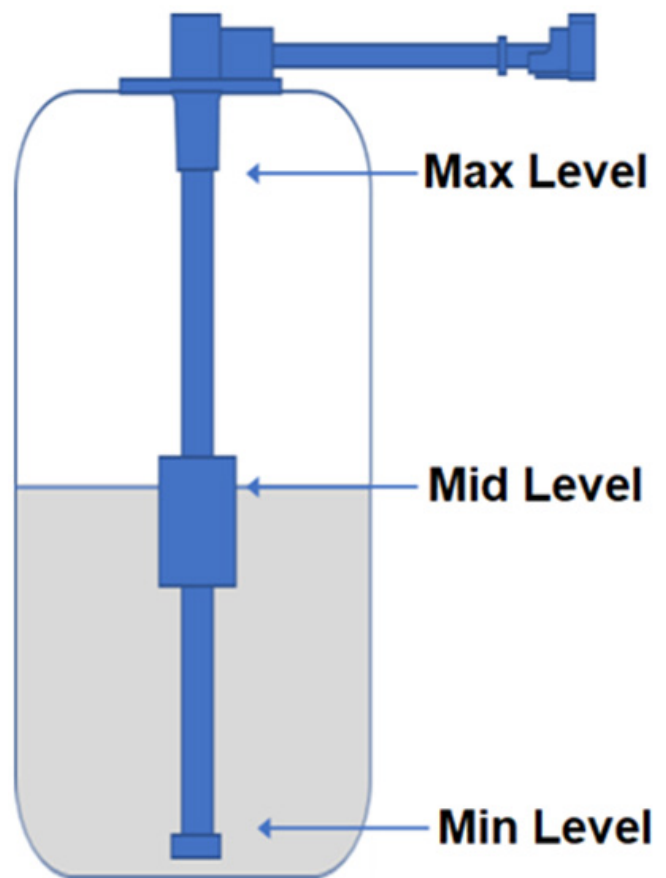
the use of a smaller size and lower-cost magnet to detect the trigger point when the fluid goes above or below this sensing point. Furthermore, it consumes very little current, as low as 110 nA, making it a very power efficient solution for these liquid sensors, where the power budget is critical.

The point-level liquid sensor is similar to the working principle of a universal-relay (UR) transducer, whereby a chain of CT8131BVs and resistors are implemented together to detect the movement of the magnet as it moves up and down a non-magnetic guide rail or tube based on the amount of liquid that is currently in the tank/container. The CT8131BVs and resistors are spaced closely together and at equal distance from one another on a printed circuit board (PCB) that is placed inside the guide tube or rail. When the liquid level rises and falls, the magnetic float moves and triggers a latch in the chain of CT8131BVs that generates a proportional voltage from the output of these magnetic latches. This output voltage is then fed into an amplifier and buffer and produces a variable output range of 10% to 90% of the voltage supply (V_{CC}). The number of points for the liquid sensor is defined by the application requirements and ranges from 1 to n, where n is the total number of sensor points. The liquid-level transmit circuitry can then be paired with a microcontroller and LCD display to provide meaningful data to end users.

SCHEMATIC AND BILL OF MATERIALS

A schematic diagram of a point-level liquid sensor using Allegro CT8131BV devices is shown in Figure 1. In this example, a total of seven CT8131BVs are used to create seven sensing points to detect the level of fluid in a tank. The bill of materials (BOM) for this implementation of a seven point-level liquid sensor is shown in Table 1. It is recommended that a bypass capacitor of 1.0 μF be added to the supply voltage pin (VCC) of TLV342.
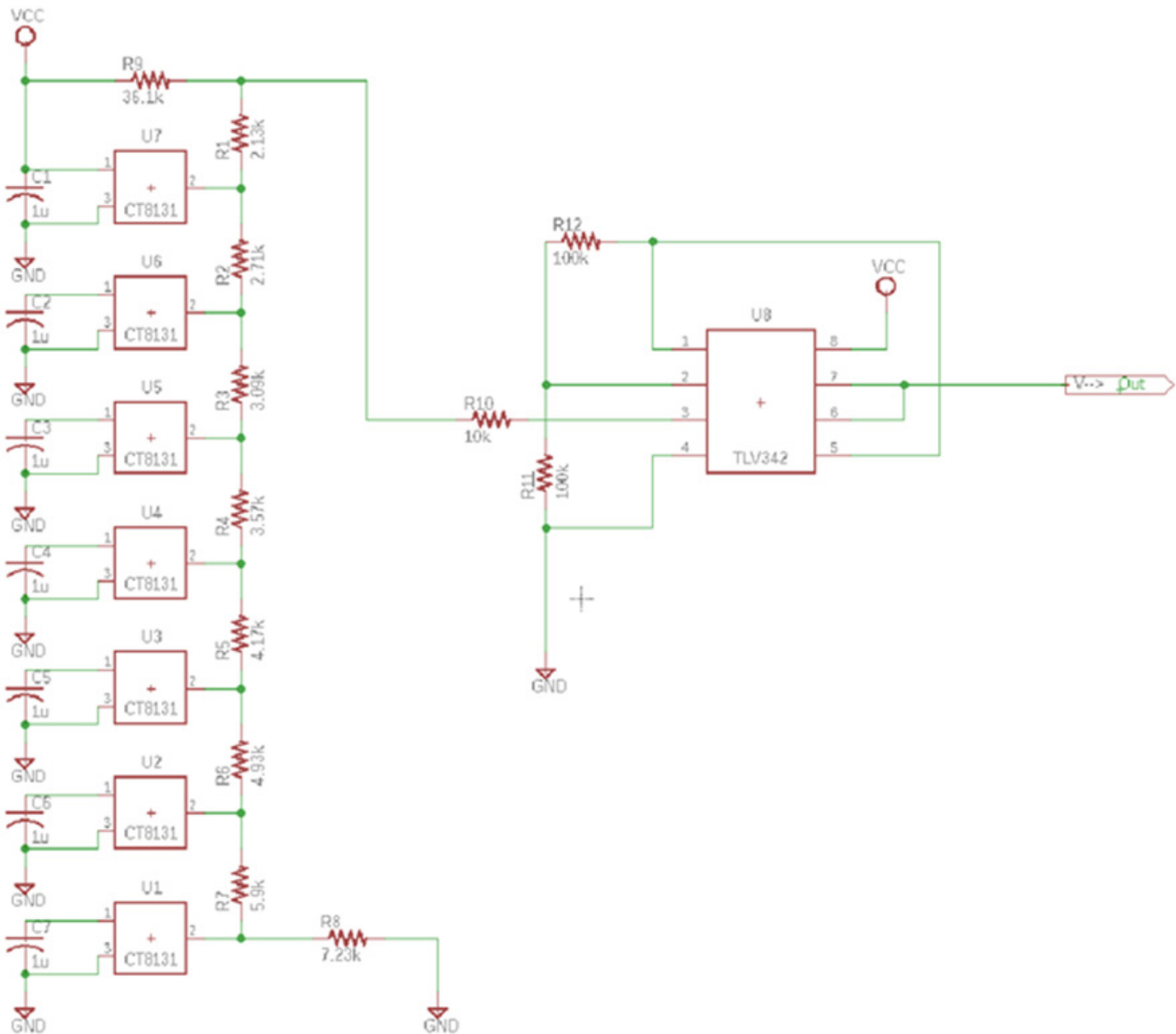

Figure 1: Schematic Diagram of a Point-Level Liquid Sensor Implemented with CT8131BV TMR Digital Latches

Table 1: Bill of Materials (BOM) List

Part Number	Part Description	Supplier	Location	QTY
CT8131BV	TMR Digital Latch with Open Drain Output	Allegro MicroSystems	U1, U2, U3, U4, U5, U6, U7	7
TLV342	Rail-to-Rail Output CMOS OpAmp	Texas Instruments	U8	1
Various	1.0 µF, X5R or better	Murata, AVX, Yageo	C1, C2, C3, C4, C5, C6, C7	7
Various	2.13 kΩ, ±5% or better	Panasonic, AVX, Yageo	R1	1
Various	2.71 kΩ, ±5% or better	Panasonic, AVX, Yageo	R2	1
Various	3.09 kΩ, ±5% or better	Panasonic, AVX, Yageo	R3	1
Various	3.57 kΩ, ±5% or better	Panasonic, AVX, Yageo	R4	1
Various	4.17 kΩ, ±5% or better	Panasonic, AVX, Yageo	R5	1
Various	4.93 kΩ, ±5% or better	Panasonic, AVX, Yageo	R6	1
Various	5.90 kΩ, ±5% or better	Panasonic, AVX, Yageo	R7	1
Various	7.23 kΩ, ±5% or better	Panasonic, AVX, Yageo	R8	1
Various	36.1 kΩ, ±5% or better	Panasonic, AVX, Yageo	R9	1
Various	10 kΩ, ±5% or better	Panasonic, AVX, Yageo	R10	1
Various	100 kΩ, ±10% or better	Panasonic, AVX, Yageo	R11, R12	2

Revision History

Number	Date	Description	Responsibility
1	November 13, 2023	Document rebrand and minor editorial corrections	J. Henry

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