copenhagen atomics

Liquid Level box V1.5

Measures liquid level with ~1 mm accuracy, liquid density and cover gas humidity

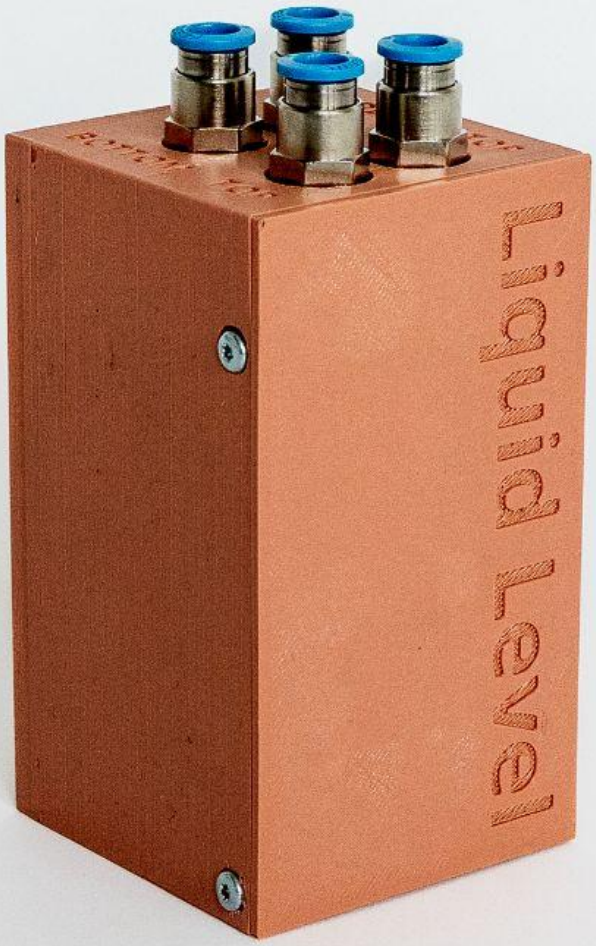

Photo showing version 1.5

Introduction

Usage

This box allow you to measure liquid level in a tank by pushing out bubbles at a known height above the tank bottom. The pressure it takes to make a bubble, give you the liquid level in the tank.

There are a small pump and pressure sensors inside the plastic box and it uses the cover gas of the tank for the bubbles.

The bubble sensor has two nozzles at two different depths, which also allow measurement of the density of the fluid.

The board uses 4 8mm hose quick connectors to the tank. Two for the cover gas (e.g. Tank top) and two for gas to the bottom of the tank.

Data communication

Data communication happens over USB with the serial communication protocol (COM-port, /dev/ttyXX).

Baud rate 115200, with 8 data bits, no parity, and 1 stop bit. (8N1)

After you connect to the board it will output one line of text to the terminal every 0.1 second (10 Hz).

The content of this line is specified on the next page.

You can also send commands to the board. Just type in a command, then the board will turn valves on and off accordingly. See page 7 for more commands.

This video gives an introduction to serial data and commands: https://youtu.be/-64MM8h5SdI

Introduction

Integration with TurboCtrl

TurboCtrl AutoConfig will detect the board and insert each channel in IO.conf as a liquidlevel value Density and liquid level and gas temperature and humidity (absolute and relative) will automatically be show in the web chart. It shows two liquid levels, one which averages over 2 seconds and one which averages over 60 seconds.

This video gives an introduction to autoconfig: https://youtu.be/MhT1DqOuWLE

This video gives an introduction to TurboCtrl programming: https://youtu.be/MhT1DqOuWLE

TurboCtrl.ai supports many other sensor and actuator types:
Temperatures, pressure, humidity, oxygen and other gasses, gas and liquid flow sensors, DC ports, AC ports, VFDs, current, voltage, oven controllers, light controllers, motors, audio, video, scales, position, liquid level, density, viscosity, integration with Festo and other pneumatics systems. And much more

Buy connectors

This board uses KANGNEX WJ2EDGK-5.08-2P connectors for 24V DC power.

You can buy the 24V connectors here: https://lcsc.com/product-detail/Pluggable-System-Terminal-Block_Ningbo-Kangnex-Elec-WJ15EDGK-3-81-2P_C8466.html

The board come with a USB-C to USB-C cable included and standard DIN rail mounting.

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For more information, please contact sales@copenhagenatomics.com

Specs

Serial terminal output (baud: 115200)

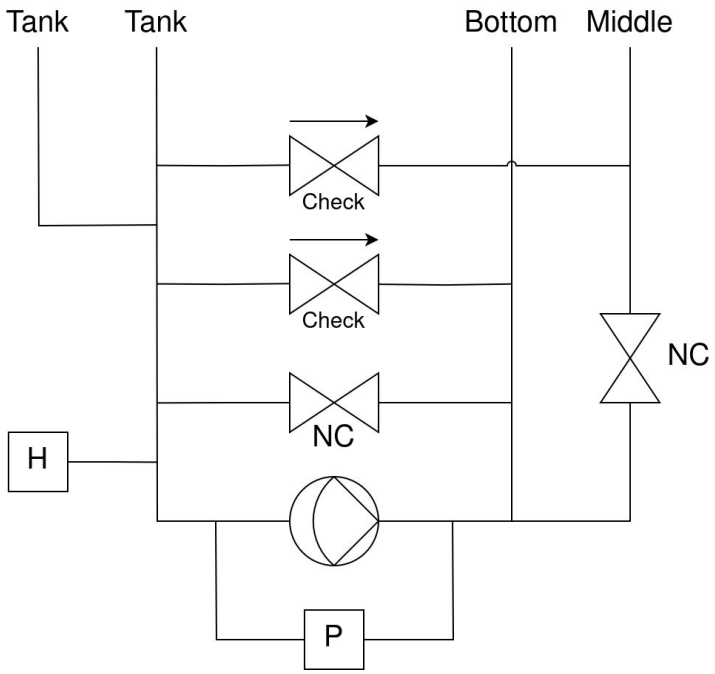
Output	Liquid Level	Liquid Density	Compensated Pressure	Pressure Sensor Temperature	Raw Pressure	Fast Pressure	Fast Liquid Level[1]	Relative Humidity	status code (see next page)
Unit	[mm]	[kg/m^3]	[mBar]	[°C]	[mBar]	[mBar]	[mm]	[%RH]	[-]

1) Fast output includes no average filter. The response time is quicker, but it is less precise

IO config setup

Format	Examples	Description
LiquidLevel;Name;BoxName;[FLiNaK|water];[PipeTipRadius_mm];[ThermocoupleName];speed;SpeedFieldOrFixed	LiquidLevel;lvl;lv01;water;2.5 LiquidLevel;lvl;lv01;FLiNaK;2.5;TankSide_degC LiquidLevel;lvl;lv01;FLiNaK;2.5;speed;Lvl_speed LiquidLevel;lvl;lv01;water;2.5;TankSide_degC;speed;Lvl_speed	Basic setup
Math; Lvl_conf_speed; 2000 Math; Lvl_speed; if(<TankSide> > 500, Lvl_conf_speed, if((<TankSide> > 490 && Lvl_speed > 1), Lvl_conf_speed, 0))		Setup to reduce salt melt backflow

Internal Schematic



Specs

Specification

Parameter	Condition	Value	Unit(s)
Level Measurement Range[1]	min.	51	mm
	max.[2]	500	mm
Maximum gauge (positive only) pressure	typ.	350	mBar
Level Measurement Accuracy[3]	typ.	±10	mm
Level Measurement Precision[3]	typ.	1	mm
Level Measurement Stability[3]	typ.	±5	mm
DC input voltage	typ.	24	V
USB power	max.	0.43	W
USB current	max.	85	mA

1) Range above end of lowest tube
2) For Thorium Salt - can go higher for FliNaK or Water
3) Post calibration

Specification

The last output of the Liquid Level board is a 32-bit status code. The 16 most significant bits are general status bits available across all boards as listed below.

Bit 31 (MSB)	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25
Error bit	Over temperature	Under Voltage	Over Voltage	Over Current	Version error	USB error

The 16 least significant bits are board specific, as follows:

Bit 16 - 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2 - 0
Reserved	Pressure not calibrated	Amplified Pressure out of range	Density Valve On	Pump On	Position in measurement step sequence

Calibration

Liquid Level boards are temperature and pressure calibrated in house.

When installing, the following calibration must be done:

- Calibration of pipe resistance
  - Connect the probe to the box, and make sure the tank is empty
  - Stop the sequence (See commands section)
  - Start the pump (See commands section) at 1000 sps
  - Wait 1 minute
  - Send *CAL 1,0,0,0*
- Input of level offset
  - Measure the distance between the bottom of the tank and the bottom of the lowest tube
  - Send *CAL 3,<distance_mm>,0,0*
    - E.g. if the distance is 5 mm: *CAL 3,5,0,0*

Specs

Commands

Command	Example	Description
pump <pump_speed_sps>	pump 1000	Moves the pump at 1000 steps per second
valve <0|1> <on|off>	valve on 0 valve off 1	Opens / closes the density (0) or auto-zero (1) valve (on = open)
seq <pump_speed_sps> seq off	seq 2000	Starts/stops the level measuring sequence with the given pump speed. • pump speeds below 5000 sps are optimal. Most testing has been performed using 2000 sps. • The sequence takes ~1 minutes to start. During this time (or while no sequence is running), the liquid_mm output will stay at -1.
Status	-	Verbose output of the current board status.
Serial	-	Verbose output of serial number and calibration.

Product photos

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Copenhagen Atomics reserves the right to change or update information and values of this datasheet at any time without prior notice. Please inquire for the current version.