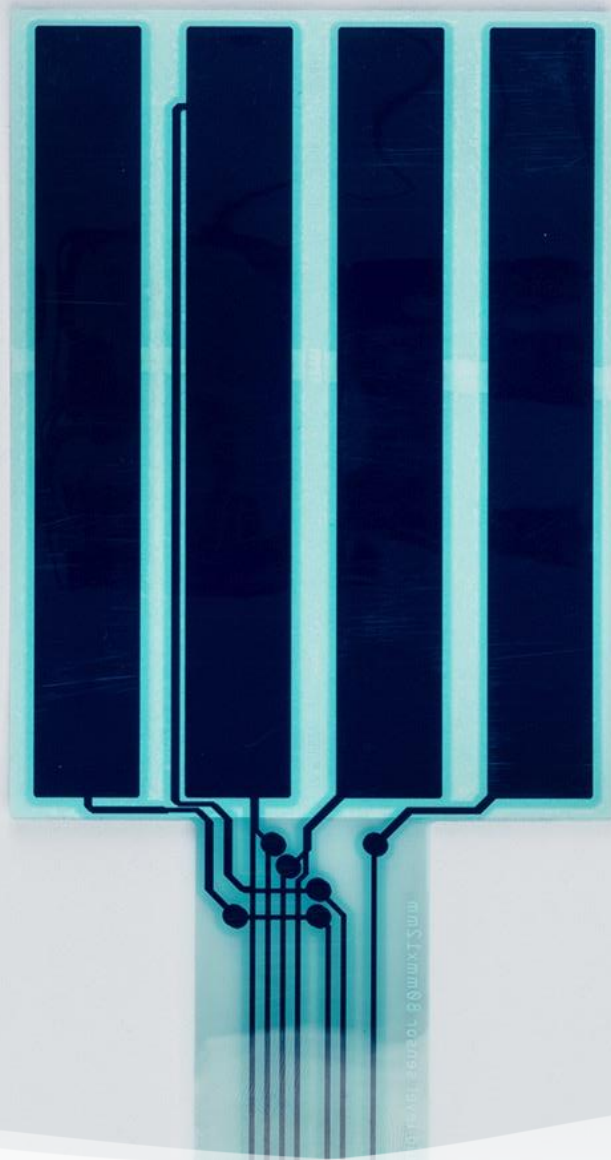TECHNICAL INFORMATION SHEET:

# NON-CONTACT LIQUID LEVEL SENSOR

BY LAIIER®

**Henkel** Qhesive
SOLUTIONS

# TECHNICAL INFORMATION SHEET
NON-CONTACT LIQUID LEVEL SENSOR BY LAIIER®

Non-contact liquid level sensor INKxperience created by LAIIER enabled by Loctite® printed electronics inks.

The non-contact liquid level sensor showcased by Henkel Qhesive Solutions is engineered and created by LAIIER. The non-contact liquid level sensor is based on a combination of printed electronics and hardware creating a capacitive printed sensor that can monitor the liquid level from the outside of any non-metallic container without being in direct contact with the liquid. The sensor and breakout board included within the Sensor INKxperience Kit were developed of the original LAIIER Trent sensor technology, which allows to transmit data to LAIIER's Surface to Cloud™ online platform. The non-contact
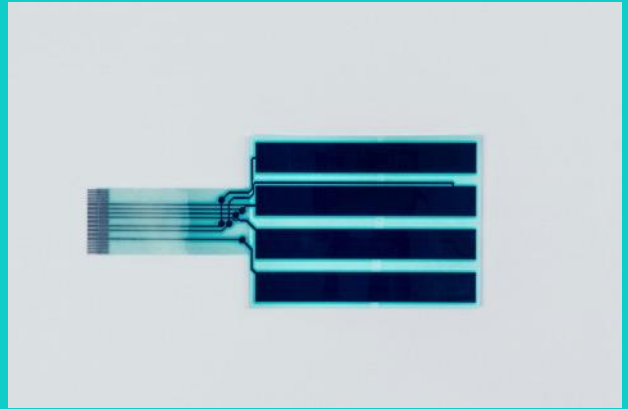
liquid level sensor is printed on polyethylene terephthalate (PET) substrate with Loctite carbon and dielectric ink. The capacitive sensor strip has electrodes that combined, report the level of the liquid to the Raspberry Pi. Printed designs determine system sensitivity due to the physically thin sensor format.

## Features

- Easy installation
- Physically thin sensor format
- Self-adhesive mounting available
- Conformable to compound surface geometries
- Physically robust and chemically resistant

## Operating Mode

The primary use case of this sensor is to detect the level of liquid within a non-metallic container, without direct contact. The event of liquid level is defined based on capacitive sensing. Conductive ink is used to print three electrodes that combined determine the level of the liquid. The capacitance changes can be read out on the Raspberry Pi.

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## Product Nomenclature

The non-contact liquid level sensor by LAIIER is composed of two main physical components, the electronic 'hardware' and printed 'Non-Contact Liquid Level Sensor'. We refer to the Printed Circuit Board [PCB] and plastic enclosure as the 'hardware' and breakout board.

A sensor is composed of three individual electrodes, that combined, report any changes in the level of the measured liquid.
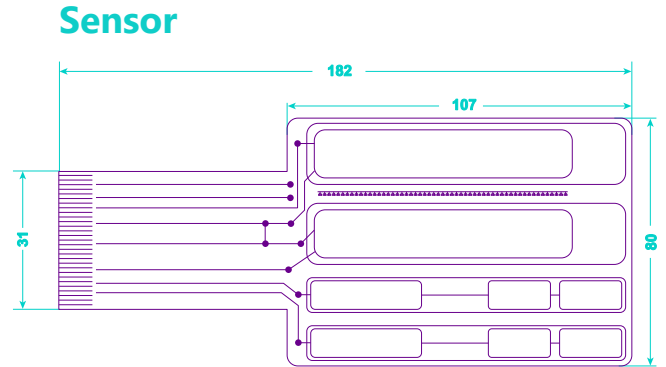
## Sensor

| Technical Summary | |
|---|---|
| Hardware and Enclosure Dimensions | 95 x 60 x 24 mm |
| Sensor Dimensions | 182 x 80 mm |
| Hardware and Enclosure Weight | 70 g |
| Operating Temperature Range | From -20 °C to  55 °C |
| Sensitivity | 5 ml |
| Resolution | Depends on the volume, thickness and material of the container |
| Activation Method | Change of the liquid's level |
| Operating Voltage | Hardware & sensor: 3.6 V |
| Housing | Nylon, not currently Ingress Protection [IP] rated |
| Mounting | Self-adhesive |
| Sensor Connector | FFC |
| Sensor Materials | Loctite EDAG PF-407A,  Loctite EDAG PF-455B |
| Sensor Function | Capacitive sensor |

| Sensor Limitations | Hardware Limitations |
|---|---|
| The non-contact liquid level sensor can detect a range of liquids through non-conductive containers, it does not work on conductive containers, such as metal. | The hardware is designed to work with the given setup. When modifying the PCB function and safety cannot be guaranteed. |

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## Data Output

The sensor data can be read out via the Raspberry Pi or the web app. Each sensor breakout board outputs data over USB serial. USB driver installation information is available here. The Non-Contact Liquid Level Sensor breakout board outputs 3 signals over USB with the serial protocol settings being: 115200 baud rate, no parity, 1 stop bit. The serial output is 3 integers separated by tabs, per line. LAIIER® user guide:  https://www.laiier.io/trent/evaluation-kit/user-guide

### Data Read Out & Saving via Raspberry Pi

The included main board (Raspberry Pi) allows for immediate testing and data read out. Once you have connected the Raspberry Pi to a power source, one or more sensors can be connected at the same time. With a power supply in place the Henkel Qhesive Solutions dashboard will boot.



From the dashboard you can select the sensor technology you would like to use, for example the leak detection sensor. Detected sensors are highlighted in green while not connected sensors are grayed out. Once the leak detection sensor is connected, tap on the respective application to see the data readout in real time.  Tap on exit to return to the menu.
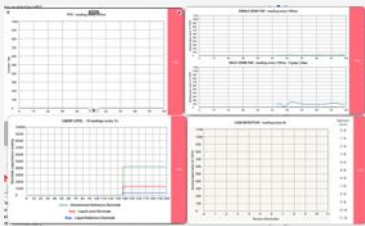


The Raspberry Pi supports automatic saving of data on a USB stick. With the Sensor INKxperience Kit you will receive a USB stick with the required filesystem: FAT32.  Once the USB stick is plugged in, a dialog window will open. Please select "Cancel".



While the USB drive is plugged in, every data reading session will save a new file on the drive. Filenames are in the form (SENSOR_NAME)_(timestamp).txt.
Each line in the file contains a timestamp (milliseconds since session start) and the analog data value read from the sensor. A data reading session starts when you tap an available sensor and ends when you tap "Exit".
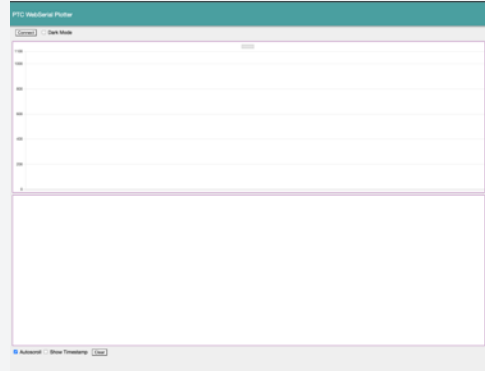
To shutdown the Raspberry Pi, unplug the power supply.

### Data Read Out & Saving via Web App

The web app allows you to read data from the sensor breakout boards by directly connecting them to your computer, without needing to use the included Raspberry Pi. Supported browsers Chrome and Microsoft Edge.

After connecting a breakout board to an available USB port, go to Qhesive WebSerial Plotter (inkxperiencekit.com) and click on the type of sensor for which you want to see data. Next, click on "Connect" and select the correct board name from the popup window.

For each sensor you can see the data graphically at the top of the page and the analog data output at the bottom of the page in real time.



To save the raw data read during the session, click the download button of the web app and save the file to your chosen location. Each line in the file contains a timestamp and the raw data read by the sensor.

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## Getting Started - Use Case

**1**

Open the breakout board hardware encapsulation case and connect the non-contact liquid level sensor to the breakout board.

**2**

Turn the switch on the breakout board to "ON" and close the breakout encapsulation case. Apply power to the Raspberry Pi, by using the power cable. Connect the connector cable to the breakout board and the Raspberry Pi.

**3**

Once the screen of the Raspberry Pi has lit up and the Henkel Qhesive Solutions dashboard is visible, select the "liquid level sensor" application and wait until the screen for data read out opens.

**4**

Fill a glass or non-metallic container with water to 50%. Watch how the liquid level read out on the Raspberry Pi. The graph will show an increase of liquid level.

**5**

For longer attachment of the non-contact liquid level sensor to a predefined container surface you can use the self-adhesive layer on the back of the sensor. Please ensure that no air is left in-between the container surface and the sensor when adhering the sensor.

**6**

To save the collected data throughout future experiments you can plug in a USB stick [Filesystem FAT32] to the Raspberry Pi. The raw data from your test setup will be saved automatically on the USB stick. Each sensor breakout board outputs data over USB Serial. Further information on how to output an save data can be found on page 4 of this document.

**7**

You are ready to start your ideation! For questions regarding the setup please contact:

**printed.electronics@henkel.com**

Check out our video tutorial on how to get the leak detection sensor INKxperience started:

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## Legal Disclaimer

This product is a B2B product, intended for research and technical feasibility validation only. For installation and application follow the recommended processes carefully.

All pieces were selected by Henkel. The printed sensors were sourced and produced by Quad Industries and LAIIER. The later including also compatible hardware components. All remaining  hardware components were sourced by IOX GmbH. The Loctite hardware cases are intended for protection only. All hardware cases can be opened for review of hardware components.

CAUTION: Please keep out of reach of children.

LAIIER makes wireless connected printed sensors that install like tape and detect leaks, occupancy, and more. They are building a Surface to Cloud™ Industrial IoT solution that is uniquely easy to install and scale in the smart building and smart facility. Their Surface to Cloud Industrial IoT sensor platform addresses critical use cases in the smart building, starting with liquid leaks, liquid level, moisture detection, and much more. LAIIER's solution prevents damage to structures, conserves precious resources, and reduces the release of hazardous chemicals into the environment.

Quad Industries has been at the forefront of printed electronics for more than 25 years, which makes them a reliable partner in the development and manufacturing of user interfaces and control panels for both consumer and industrial applications. In recent years, they have extended our activities in the domain of printed electronics, using their extensive knowledge to develop and manufacture printed, flexible sensor solutions. Their headquarters and production facilities in Europe are certified to the internationally recognized ISO 9001:2015 Quality Management Systems (QMS) standard. The QMS for Quad is the sum of all the processes, resources, properties, and cultural values that support the goal of customer satisfaction and productivity of the organization.

Leading companies have innovative IoT concepts but are challenged when it comes to turning them into reality. IOX LAB helps them and creates prototypes exceptionally fast: In 30 days from idea to prototype. To make this possible, the start-up uses IoT technologies as sensors, motors, 3D printing and artificial intelligence. The team covers the full stack of IoT. Make things, not slides: ioxlab.de

## Summary of components

| Component | Subcomponents | Certifications |
|---|---|---|
| **FSR Sensor Breakout Board** | PCB: <br>• Seeeduino <br>• Current sensor INA219 <br>• Resistance <br>• Solder | PCB: <br>• Standard IPC-4101 <br>• Flammability class V0 <br><br>Seeeduino: <br>• Certifications: CE & FCC <br><br>Connectors: <br>• Recognized E60389 <br>• Certified LR20812 <br>• 2R75087 <br><br>Resistance: <br>• RoHS 2011/65/EU <br>• Solder: <br>• Lead-free <br>• 96.5% Sn, 3.0% Ag, 0.5% Cu |
| **Leak Detection Breakout Board** | PCB by LAIIER (Bare Conductive Ltd): <br><br>SKU-8502 - Severn Evaluation Kit (containing Bravo Board PCB) | European Declaration of Conformity (08/02/2023) by Bare Conductive Ltd.: <br><br>The EMC Directive 2014/30/EU and RoHS 3 Regulation (EU 2015/863). The components contained within the listed PCB boards are compliant with the <br>• RoHS 3 Regulation (EU 2015/863) and <br>• EMC Directive 2014/30/EU <br>• Standards EN 55032:2015+A11:2020 and EN 55035:2017 |
| **Non-Contact Liquid Level Breakout Board** | PCB by LAIIER (Bare Conductive Ltd): <br><br>SKU-8403 - Trent Evaluation Kit (containing Alfa Board PCB) | |

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# FROM PRINT TO UNBOX.
# FROM IDEATION TO PROTOTYPE.
# **FROM TESTING TO ACCELERATION.**

**FOR FURTHER INFORMATION:**

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PRINTED.ELECTRONICS@HENKEL.COM

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