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TTLLS-Cable Liquid Level Sensors User Manual

PATENT PENDING

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Functionality

The Typhon Technologies TTLLS-Cable is an Electronic Liquid Level Sensor, cost efficient and reliable level sensor used for liquid level measurement in all types of cooling systems.

The Liquid level sensor is used for monitoring the liquid level in standpipes and other applications, where level monitoring is needed. The liquid level sensor has an analog output, which can be selected as either mA or Voltage for indication for 0-100% level.

The installation is simple with only one-point installation, it comes with different thread types. TTLLS-Cable have smart commissioning via Bluetooth connected to the TT SmartConfig App, which easily allows the user to select the desired refrigerant media and control the output.

With the TTLLS-Cable and the High-end technology within the capacitive measuring principle, combined with integrated AI technology and conductance measurements it takes the Liquid Level Sensor to a new level, offering cost-efficiency, reliability, and user-friendliness. This high-end technology also makes it possible to not use any isolating material on the electrode, which also adds the features of only having one mechanical part. Use the same mechanical part for everything, just configure the switch for the selectable use via TT SmartConfig App.

All sensors have built-in 1000VAC Galvanic Isolation – Increase reliability and sensitivity.

The capacitive measuring principle makes sure that the mechanical part is never worn down, because there are no moving parts inside the mechanical part. Because of the High-end patent pending technology within the capacitive measuring principle the same mechanical part can be used within all types of refrigerant media.

TTLLS-Cable is constructed with the user in mind, it easy to install with only one connection point, and replacement of the electronic part can be done without affecting the pressurized or empty the subsystem.

The TTLLS-Cable detect level in all types of refrigerant media e.g. NH3, CO2, HFC, HFO, CFC, OIL, Alcohol, and Water (Pure) – Simply connect to the TT SmartConfig App and configure the sensor for the given application.

*Measurement in Butane, Propane, Isobutane is possible, however the TTLLS-Cable is not EX certified.

The TTLLS-Cable shall be installed in standpipe from 1” to 4” standpipe, if necessary to measure directly into a vessel or tank use the TTLLS Liquid Level Sensor.

The TTLLS-Cable is not suitable for marine applications, use the TTLLS Liquid Level sensor.

Features

- Plug and play liquid level sensor
- One-point installation
- One level sensor – Easy configuration of liquid type and output by TT SmartConfig App
- Advanced measuring technology – not impacted by metal parts or any conductive parts
- AI integrated technology – Machine learning liquids properties, optimize long-term stable and correct liquid measuring.
- Notification of change in the media.
    - E.g. By connecting to the sensor with the TT SmartConfig the conductance can be read to see if there are changes in the conductance for the media.
- Applicable for all types of cooling and heating systems (including heat pumps application)
- 1000VAC Galvanic Isolation – Increase reliability and sensitivity
- Simplify your order/locally stock – One level sensor fits all refrigerant media
- Integrated heater – ambient temperature range -40°C to +60°C
- High pressure up to 150 bars
- Refrigerant media temperature -60°C to 150°C
- IP66 Protection Degree
- Simple configuration, diagnostic and Live data on site via Bluetooth and TT SmartConfig App
- Maintenance free
- Advanced capacitance measuring principle – No worn-down mechanical part
- No moving mechanical parts
- Replacement of electronic part without removing mechanical part
- *RF Link – connects level sensors and accessories wireless together (coming features)*
- *Augmented reality – multiple sensor information through TT SmartConfig App (coming features)*

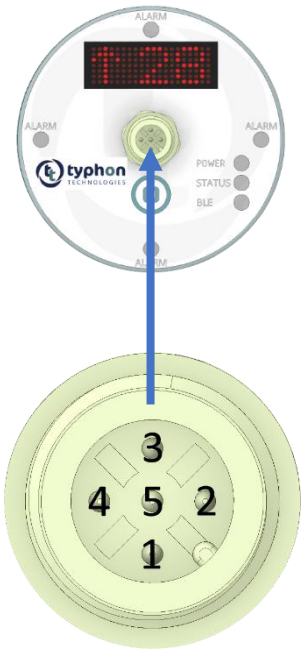
Product Specification

General	
Dimension Insert (L x D) / Outside (L)	(L) x Ø22 mm / 145mm L = 200-6000mm
Color	RGB:80/115/119
Material - Electronic	Nylon 6 PA / Stainless steel 304 / PTFE
Material - Mechanical	Stainless steel 304 / PTFE / PEEK
Power Supply	External 24V AC/DC ±10%, 5 Plug IEC 61076-2
Power Consumption	Max 600mW with heater ON
Power Output Current	Maximum 1A
Galvanic Isolation	1000 VAC
Thread Connection	¾" BSPP, ¾" NPT
Environment	
Protection Degree	IP66
Ambient Temperature	-40 to +60°C
Compatible Refrigerant media	NH3/Water (Pure)/Alcohol HFC/HFO/CFC OIL CO2 * Butane/Propane/Isobutane (TTLLS-Cable can be used but is not EX certified) Installation in standpipe from 1" to 4"
Refrigerant media Temperature	NH3: -60 to +110°C HFC/HFO/CFC: -60 to +110°C OIL: 0 to +150°C CO2: -55 to +30°C
Max Pressure	150 bar
Input	
Pin 3: mA input	Input mA: Remote set point 4-20mA / Resolution 0.002mA
Output	
Pin 4: mA output / Voltage output	Level Output: 4-20mA – Selectable range: 0-20mA / Resolution 0.001mA Selectable range: 0-10V

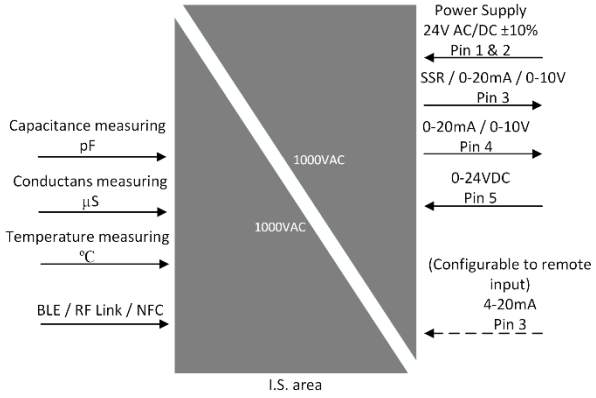
Pin 3: mA output / SSR Output Signal	control mA output / Alarm SSR Control signal 4-20mA / Resolution 0.001mA SSR Alarm (Source/Sink) (NO/NC)
Pin 5: Stop / Start Sensor	Voltage: 0V-24VDC
LED Matrix	Level 0-100% General service Information
LED Indication	1 x Blue, 4 x Red, 1 x Green, 1 x Yellow
Wireless	
RF Link (coming)	Frequency: 868 MHz Protocol: TT-custom Sensitivity Typ.: -110 dBm Output power Typ.: +15 dBm
BLE	Protocol: 5.1 Sensitivity: -88 dBM Transmit power: +8 dBm
AR – Augmented Reality (coming)	*Protocol: TT-Custom*
APP Interface	TT SmartConfig App

Electrical connection

The TTLLS-Cable liquid level sensor can be powered with an external power supply 24V AC/DC ±10% through the standard M12 5 pins IEC 61076-2 plug connector. The TTLLS-Cable is 1000VAC galvanic isolation for increasing reliability and sensitivity.



Pin 1: (Brown)	+24V AC/DC ±10%
Pin 2: (White)	-0V / Common
Pin 3: (Blue)	Input mA / control mA output / Alarm SSR
Pin 4: (Black)	Level Output mA / Level Output Voltage
Pin 5: (Grey)	Stop / Start Sensor



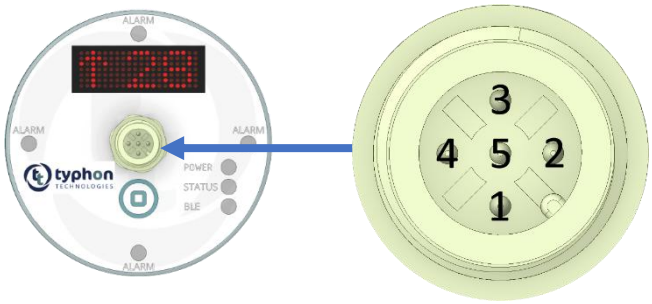
Via Bluetooth connection to the TT SmartConfig app, the Pin 3 can be selected either as SSR alarm output. If the sensor is setup for control mode, the Pin 3 can indicate the controlling status through mA or Voltage output. In control mode the Pin can also be setup as mA input, which can be used to remotely change the set point in the PID regulator.

The TTLLS-Cable liquid level sensor can be set up in either Level mode or control mode.

In control mode, the liquid level sensor can be ordered, with a controlling cable directly to a valve, such as either a 1) PWM Valve e.g. Danfoss AKVA, 2) Stepper motor valve e.g. Carel E2V or 3) mA-controlled modulation valve e.g. Siemens MVS661.

TTLLS-Cable liquid level sensor – Level Mode

In level mode the TTLLS-Cable liquid level sensor measures the level and transmit a selected analog output linear level, either as mA or voltage corresponding to the measured liquid level on Pin 4.

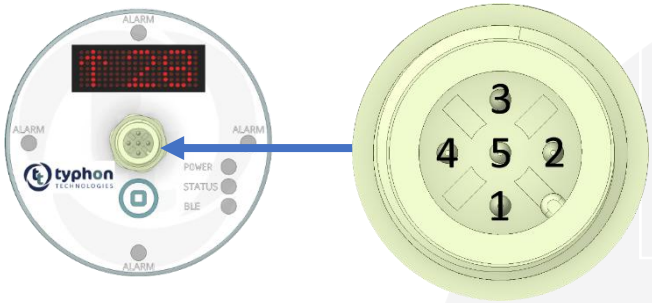


Pin 1: +24V AC/DC ±10%
Pin 2: -0V / Common
Pin 3: Alarm SSR
Pin 4: Level Output mA / Level Output Voltage
Pin 5: ---

TTLLS-Cable liquid level sensor – Control Mode

UPCOMING FEATURE !!

In control mode the TTLLS-Cable liquid level sensor measuring the level and transmits a selected analog output linear level, either as mA or voltage corresponding to the measured liquid level on Pin 4. When control mode is selected, it enables the built-in controller which can be used for regulating signals for e.g. a PLC on Pin 3. Pin 5 has a digital signal input in control mode, for stopping and starting the sensors controller.

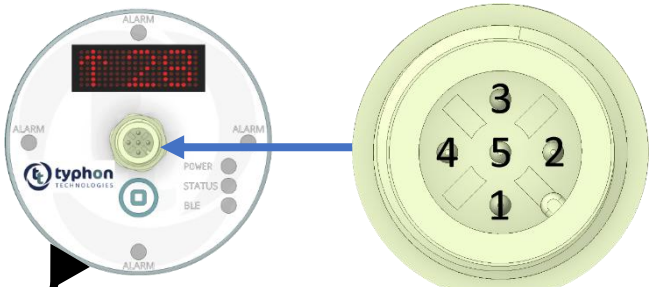


Pin 1: +24V AC/DC ±10%
Pin 2: -0V / Common
Pin 3: control mA output
Pin 4: Level Output mA / Level Output Voltage
Pin 5: Stop / Start Sensor

TTLLS-Cable liquid level sensor – Control Mode – Modulating Valve

UPCOMING FEATURE !!

TTLLS-Cable can be ordered with a cable output directly controlling a modulating valve. In control mode the TTLLS-Cable liquid level sensor measuring the level and transmits a selected analog output linear level, either as mA or voltage corresponding to the measured liquid level on Pin 4. When control mode is selected and with a cable output, it enables the built-in controller which can be used for regulating signal directly to the modulating valve. Pin 3 can be configured to either be used as remote input for changing the Set Point in the built-in controller or as Alarm output signal. Pin 5 is a digital signal input in control mode, for stop and starting the sensors controller.



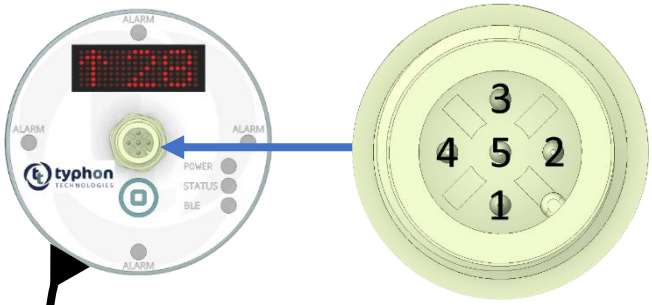
Pin 1: +24V AC/DC ±10%
Pin 2: -0V / Common
Pin 3: Input mA / Alarm SSR
Pin 4: Level Output mA / Level Output Voltage
Pin 5: Stop / Start Sensor

Pin 1: +24V AC/DC ±10%
Pin 2: -0V / Common
Pin 3: control mA output 4-20mA

TTLLS-Cable liquid level sensor – Control Mode – PWM Valve

UPCOMING FEATURE !!

TTLLS-Cable can be ordered with a cable output directly controlling a PWM valve. In control mode the TTLLS-Cable liquid level sensor measuring the level and transmits a selected analog output linear level, either as mA or voltage corresponding to the measured liquid level on Pin 4. When control mode is selected and with a cable output, it enables the built-in controller which can be used for regulating signal directly to the PWM valve. Pin 3 can be configured to either be used as remote input for changing the Set Point in the built-in controller or as Alarm output signal. Pin 5 has a digital signal input in control mode, for stop and starting the sensors controller.



Pin 1: +24V AC/DC ±10%
Pin 2: -0V / Common
Pin 3: Input mA / Alarm SSR
Pin 4: Level Output mA / Level Output Voltage
Pin 5: Stop / Start Sensor

Pin 1: +24V AC/DC ±10%
Pin 2: -0V / Common

TTLLS-Cable liquid level sensor – Control Mode – Stepper Motor Valve

UPCOMING FEATURE !!

TTLLS-Cable can be ordered with a cable output directly controlling a stepper motor valve. In control mode the TTLLS-Cable liquid level sensor measuring the level and transmits a selected analog output linear level, either as mA or voltage corresponding to the measured liquid level on Pin 4. When control mode is selected and with a cable output, it enables the built-in controller which can be used for regulating signal directly to the stepper motor valve. Pin 3 can be configured to either be used as remote input for changing the Set Point in the built-in controller or as Alarm output signal. Pin 5 has a digital signal input in control mode, for stop and starting the sensors controller.

Pin 1: +24V AC/DC ±10%
Pin 2: -0V / Common
Pin 3: Input mA / Alarm SSR
Pin 4: Level Output mA / Level Output Voltage
Pin 5: Stop / Start Sensor

A-: White pin 4
A+: Yellow pin 2
B+: Brown pin 3
B-: Green pin 1

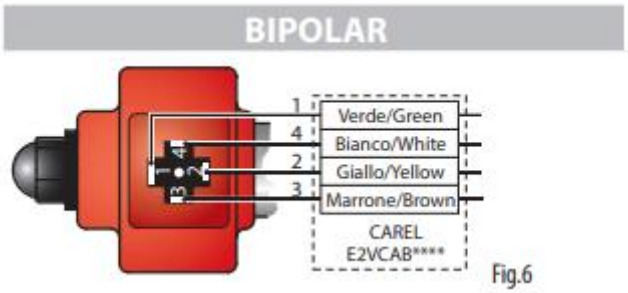


Fig.6

LED Indication

1 x Blue LED on means Bluetooth connection active

1 x Blue LED flashing indicates Bluetooth active

4 x Red LED's Indicate alarm

4 x Red flashing indicate error/warning – Connect to TT SmartConfig App for further details

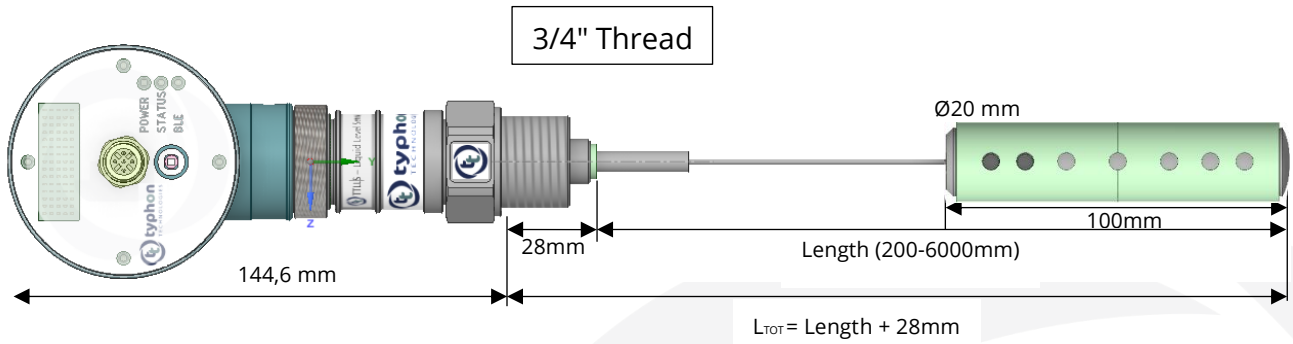
1 x Green flashing indicates sensor active

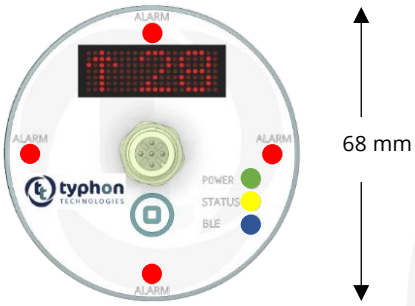
1 x Green constantly on – sensor is in control mode and waiting for start signal.

1 x Yellow. – Reserved for coming features

The LED's is activated as above, regardless of NO or NC state is selected of the SSR contact output.

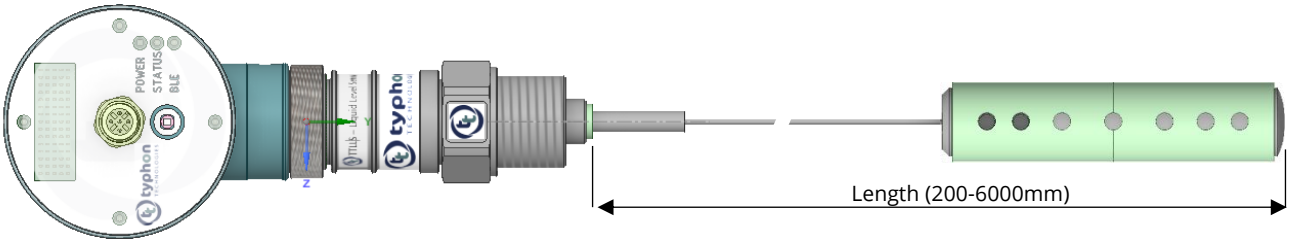
Dimension





Wire adjustment

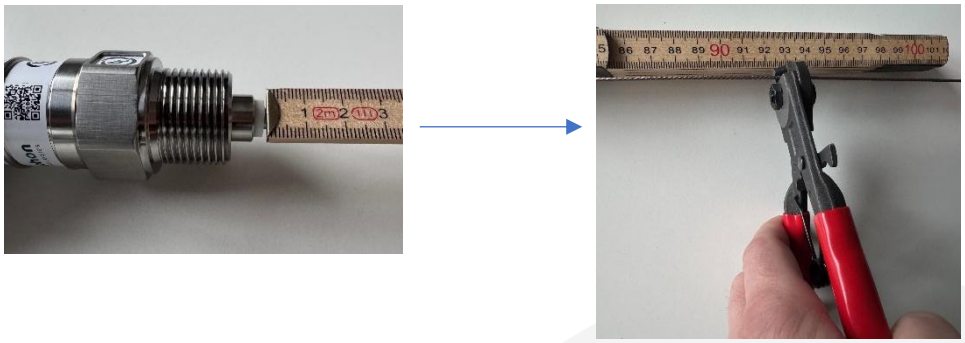
The sensor length can be adjusted between 200-6000mm.



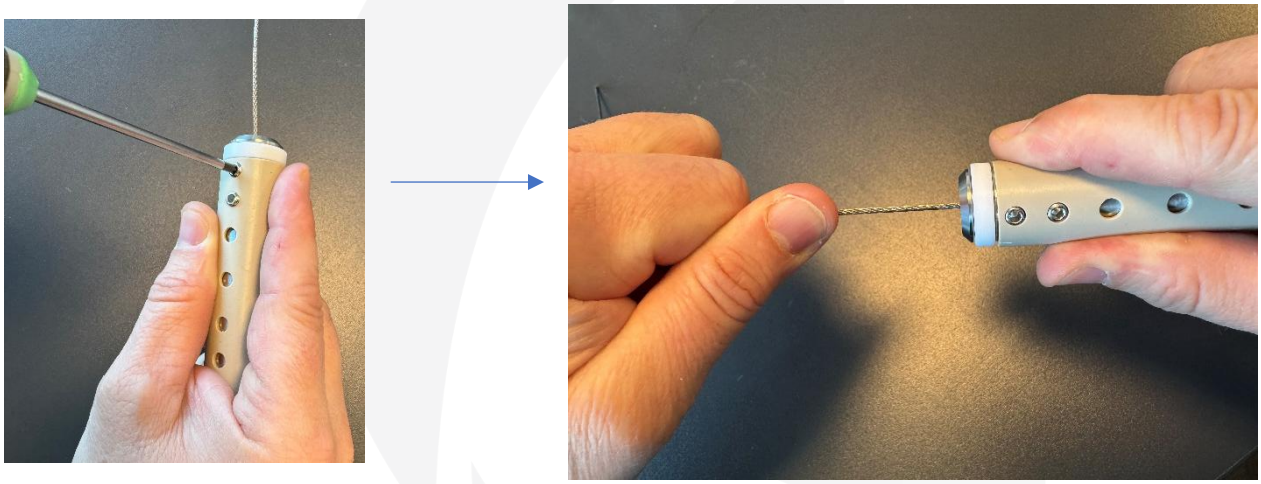
Ensure Minimum 50mm space between end of weight to botton of stand pipe.

1. Cut the wire 70mm shorter than the desired length

   Pictures illustrate how to shorten for. 1000mm length



2. Put the wire all the way down (30mm) in the middle of the weight and tighten the two screws to fix the weight on the wire. Do not remove weight protection. Make sure that the weight is fixed by pulling the weight and wire, to check if the weight is tightened.



Configuration

Bluetooth communication

TT SmartConfig app can be downloaded from IOS app store or Android google play.

All communication with all Typhon Technologies sensor is done by use of this app. Communication can only happen with one sensor at a time.

Each sensor includes its own serial number, which will appear in the app when connected. At the same time the blue LED in the actual connected sensor will be constantly ON.

Bluetooth configuration

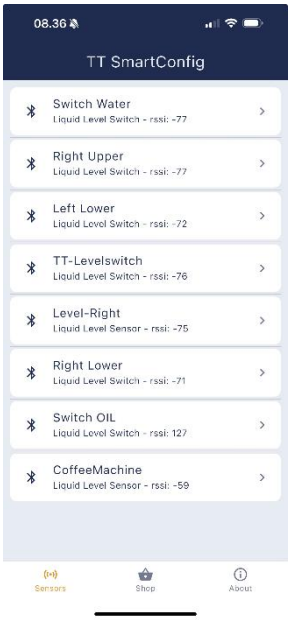
Always download or update to the latest app version.

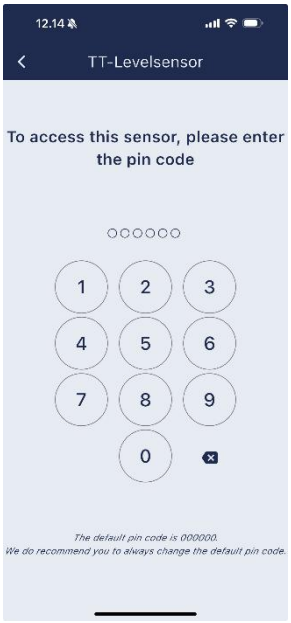
The configuration of the parameter setting of a Typhon Technologies (TT) sensor is done by opening the app and performing a scan for devices. The app will get a list of all TT sensors that are present at the actual location. The list will include a name, ID and RSSI value for each of the present TT sensors.

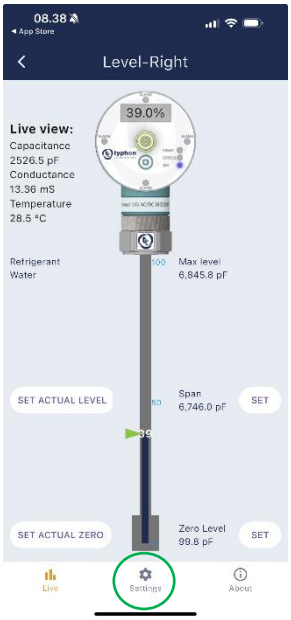
The name and configurable parameters of any sensor can be changed at any time.

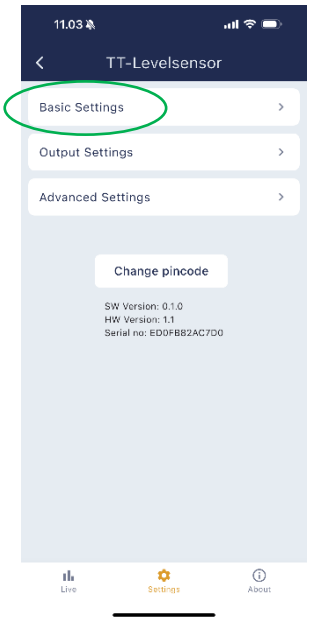
1. Press the button for activating Bluetooth (It's enabled for 5 minutes, if no connection is made.) The blue LED is flashing.
2. Connect the first item on the list and observe which sensor's Blue LED is constantly on.
3. Log-in with the provided PIN code. (Default code is 000000. For safety reasons the PIN code should be changed afterwards)
4. PIN code can be cleared by pressing the button on the sensor for 10 seconds. Blue LED turns on after 10 seconds to indicate PIN code reset.
5. Rename the device to an up to 24 symbol name (14 symbols displayed)
6. Check the parameter settings and if needed change one or several parameters. E.g. refrigerant media type, SSR State (NO/NC).
7. *Save and share the settings in text file. (coming)*
8. Disable the communication and observe that the blue LED starts flashing (Bluetooth is enabled 5 minutes after communication is disabled – blue LED is off)
9. This sensor is now ready for operation
10. If more sensors are present, connect to the next item on the list, and repeat steps 1 to 8

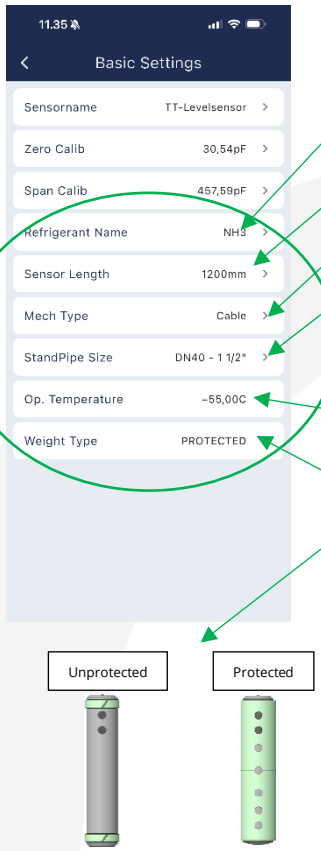
Simple Sensor Configuration











Easy configuration of sensor by: Select Refrigerant – Select refrigerant from drop down list, Enter the length of the sensor.

Enter the length in mm

Select Mech Type: Cable

Select Standpipe Size.

The sensor is automatically calibrated after these 4 (5) parameters.

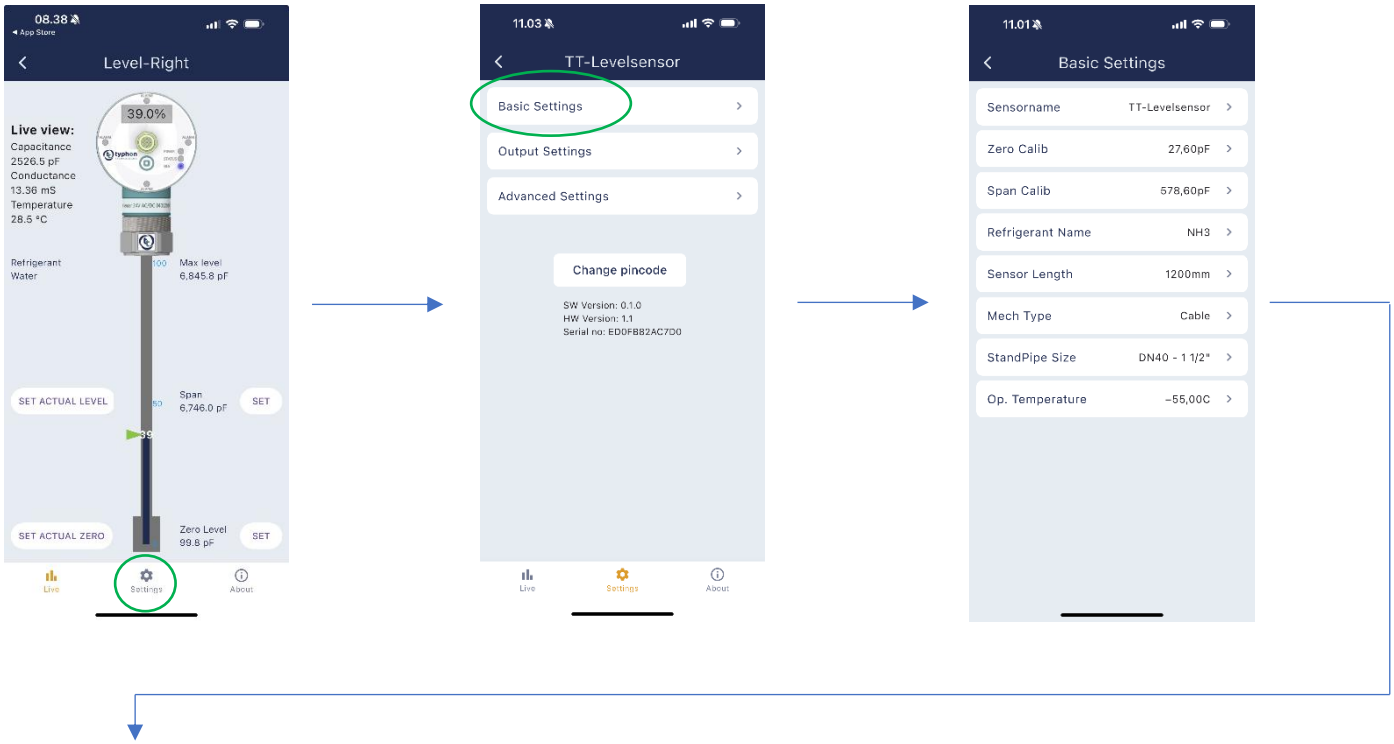
(If NH3 is selected, "Operating temperature" is possible to enter, standard is -60 - -40 °C)

Select Weight type "Protected" if the weight comes with protected capsule (Capsule with holes)

Mech Type is used if the electronic head is needed for TTLLS probe version.

The sensor is ready to use after setup of those settings!!

Basic Settings



Sensorname: can be changed to e.g. “Standpipe right”. Maximum 16 letters

Zero Calib: Change the zero calibration manually - This value is automatic calculated when Refrigerant, Length, Standpipe, Operating temperature (if NH3 selected), Minimum offset, or maximum offset is changed.

Span Calib: Change the zero calibration manually - This value is automatic calculated when Refrigerant, Length, Standpipe, Operating temperature (if NH3 selected), Minimum offset, or maximum offset is changed.

Refrigerant Name: Set the refrigerant type or oil which the sensor should be used for.

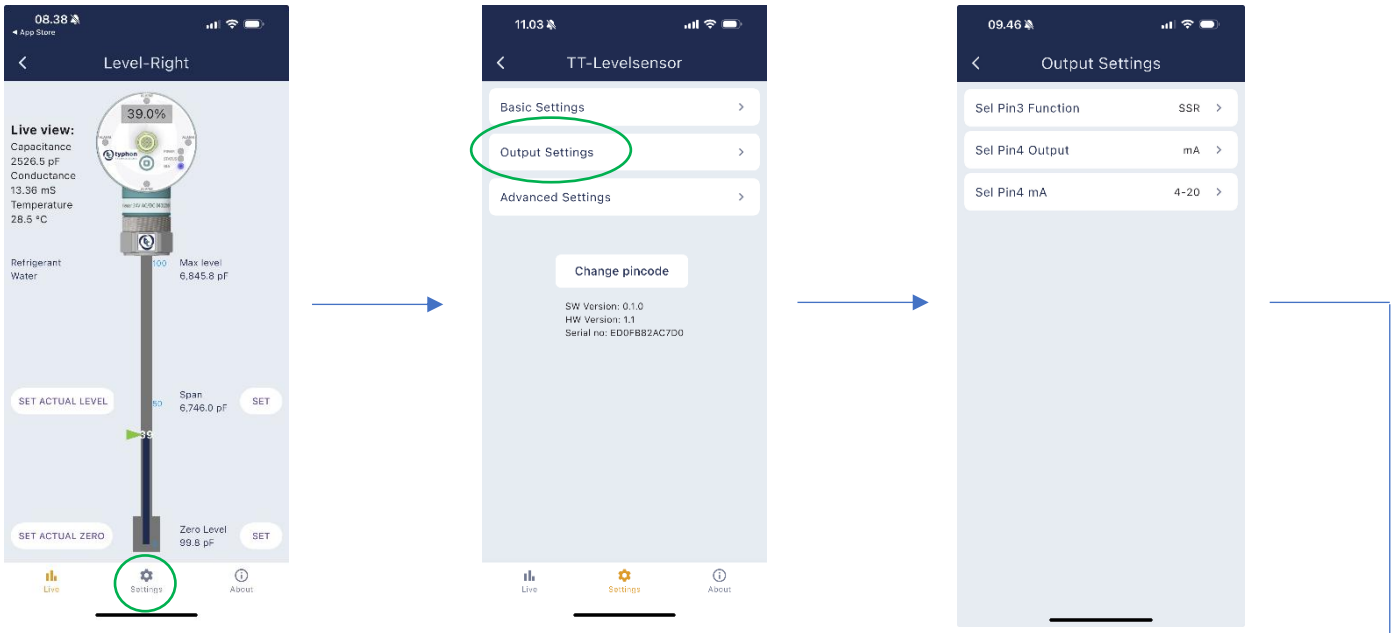
Sensor Length: Enter the length of the sensor in millimeter

Mech Type: The electronic head, can be selected either to be used for cable or probe mechanical type

Standpipe Size: Select the standpipe size which the cable level sensor is mounted in.

Operating temperature: This is set to default -55ºC - This setting is only in use when NH3 is selected, enter the approximately operating temperature the sensor is used in, this due for fine-tuning the precision for the level measurement.

Output Settings



Sel Pin3 Function: This is set to default "SSR" which is used for alarm relay output on PIN 3 on the M12 connector.
The analog output can be selected as SSR Alarm output, mA output, voltage output or mA input.

If **Pin3** analog output is selected as **SSR Output**:
Sel Pin3 SSR: Select if the analog SSR is used for indicating alarm, which level can be set in the Advanced settings. It's by default set to 80%. It means that when level is above 80% the alarm output will be activated.

If **Pin3** analog output is selected as **mA Output**:
Sel Pin3 mA: Select if the analog mA output should indicate level:
0-100% = 4-20mA, 20-4mA, 0-20mA, 20-4mA, 0-10mA or 10-0mA.

If **Pin3** analog output is selected as **Volt Output**:
Sel Pin3 vol: Select if the analog voltage output should indicate level:
0-100% = 1-5V, 5-1V, 0-5V, 5-0V, 0-10V or 10-0V.

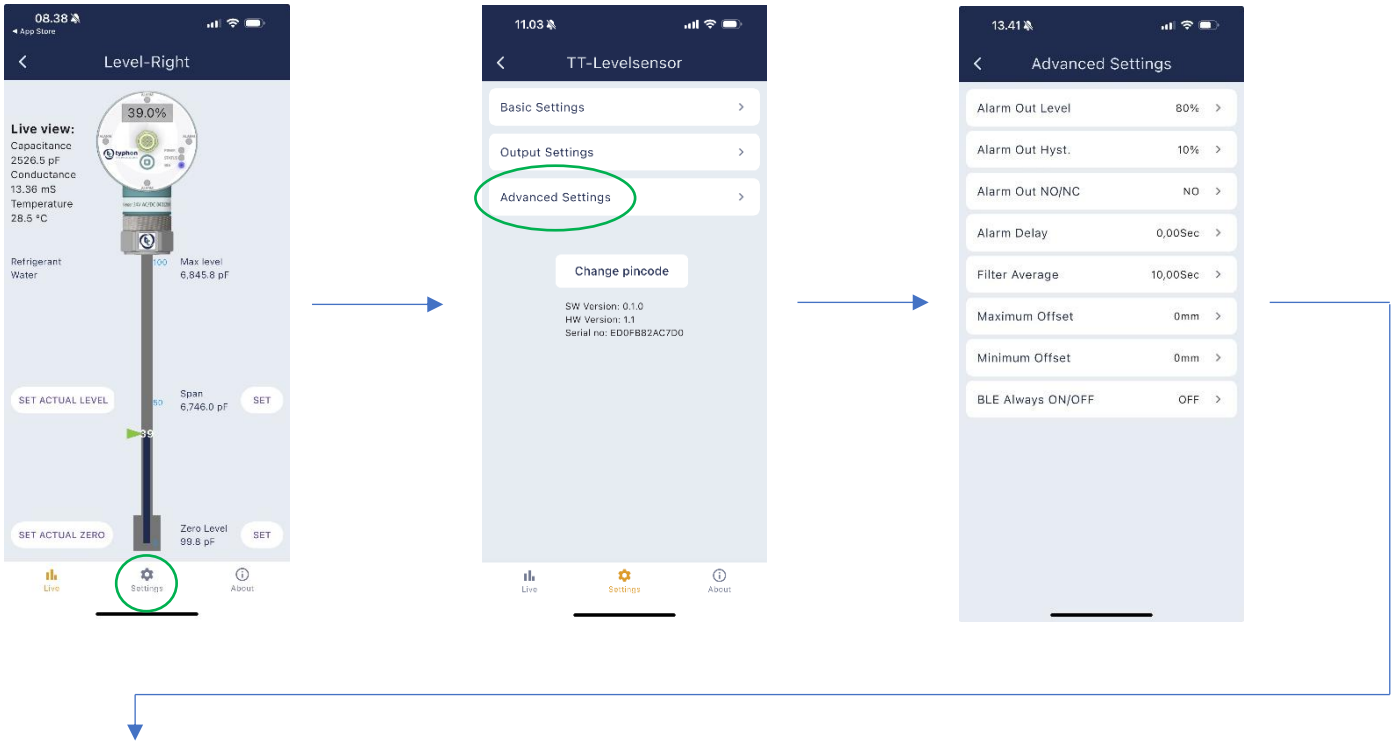
If **Pin3** analog output is selected as **mA Input**:
Sel Pin3 mA input: This function is coming – It will be used for remotely change the setpoint in the build in regulator. The input will be 4-20mA.

Sel Pin4 Output: Pin 4 is an analog output on the M12 connector which is used for indicating the level measurement from 0-100%. The analog output can be selected as mA output or Voltage output.

If **Pin4** analog output is selected as **mA Output**:
Sel Pin4 mA: Select if the analog mA output should indicate level:
0-100% = 4-20mA, 20-4mA, 0-20mA, 20-4mA, 0-10mA or 10-0mA.

If **Pin4** analog output is selected as **Volt Output:**
Sel Pin4 vol: Select if the analog voltage output should indicate level:
0-100% = 1-5V, 5-1V, 0-5V, 5-0V, 0-10V or 10-0V.

Advanced Settings



Alarm Out Level: Indicates the desired alarm level. It is given in % of max measurement range 0-100%

Alarm Out Hyst: Indicates the deviation required before the alarm is deactivated. Alarm Out hysteresis is in percent of the probes calibrated span 0 and 100%.

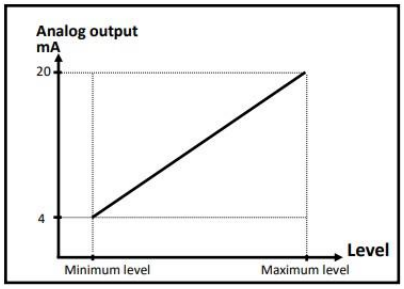
E.g. Alarm Out Level = 80%, Alarm Out Hyst = 10%
Alarm is activated when level reaches 80%, Alarm is deactivated when level drops below 70%

Alarm Out NO/NC: The Alarm relay function can be set to either NO or NC (normally open/normally closed).

Alarm Output Delay: Default set to 0 seconds. The output change of the relay function can be delayed from the sensor level is reaching the Alarm Level setting to the change of the alarm output relay is activated. The 4 x LED's is not affected by this delay, the 4 x LED's is turned on as soon the sensor reach the Alarm Level setting.

Filter Average: Default set to 10 seconds. If filter average is set to 0, the sensor uses the instantaneous measurement directly, this could cause the sensor to react to fast and be affected by fluctuation in the liquid. Higher filter average value makes the sensor less sensitive for fluctuation in the liquid and a steadier measuring.

Offset Maximum and Minimum: Offsetting minimum and maximum if your sensor height doesn't match your vessel height; it is possible to move the minimum level and maximum level beyond the physical sensor by adjusting the Offset Maximum and Offset Minimum. The output is scaled linear from minimum to maximum offset.



BLE Always ON/OFF: Bluetooth is by default set OFF, push the button for activating the Bluetooth. The bluetooth is activated for 5 minutes if no connection is made.
BLE set ON, bluetooth is always enabled.

Mechanical installation

The installation of the Level Sensor depends on the type of thread, for those with NPT thread, Teflon tape or liquid conductive sealant can be used. For NPT thread it's important that the thread has electrical connection to the standpipe. Using liquid conductive sealant electrical connection is insured. Using Teflon Tape do only apply on part of the thread.

Parallel (straight) thread as BSPP is installed with aluminum gasket, which is delivered together with the sensor. While using aluminum gasket, this will always ensure electrical connection between standpipe and sensor.

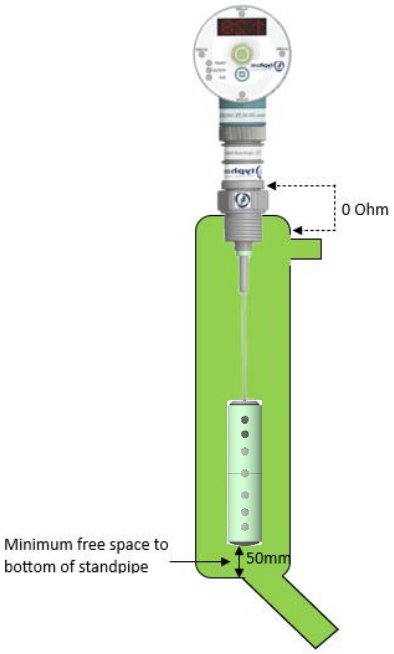
Always ensure that the thread has an electric connection to the standpipe. This can easily be measured by an ohm meter between the standpipe and the sensor. It should measure 0 ohms.

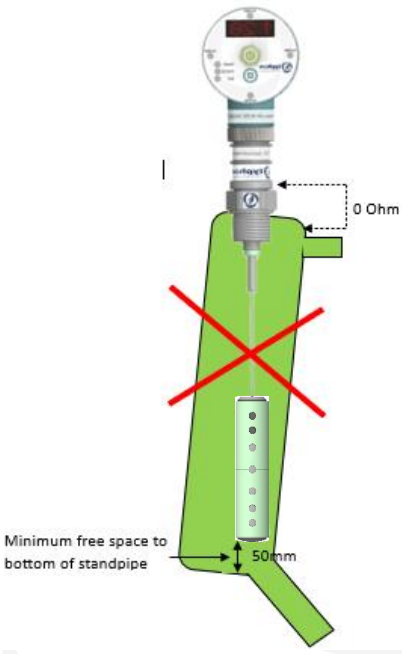
The TTLLS-Cable shall be installed in standpipe from 1" to 4" standpipe.

CAUTION! In the case of welding work on the unit, we recommend removing the electronic head or at least making sure that proper earthing is carried out to avoid damaging the electronics.

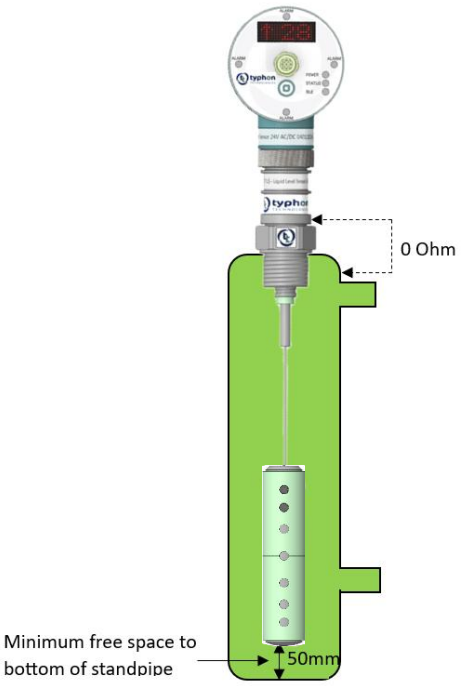
The following applies to the design of the system:

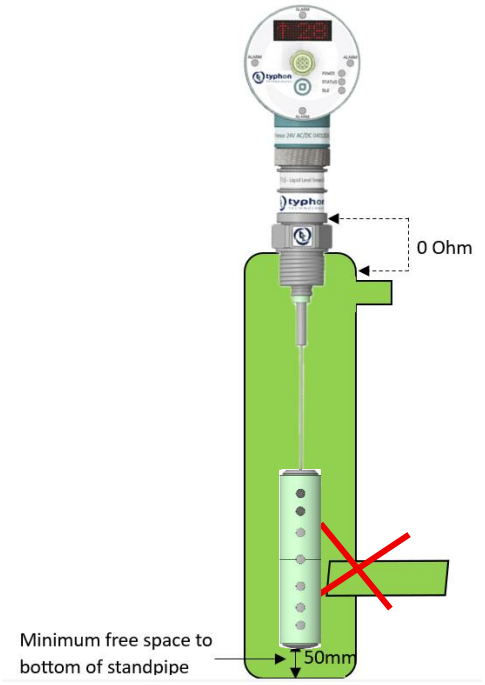
- TTLLS-Cable Liquid Level Sensor must be installed in a vertical position
- Standpipes shall be in vertical position, otherwise a re-calibration needs to be done.
- The inlet pipe from standpipe shall be mounted at an angle of 5-10 degrees from horizontal. This drains the standpipe from oil.
- Minimum 50mm free space in bottom.





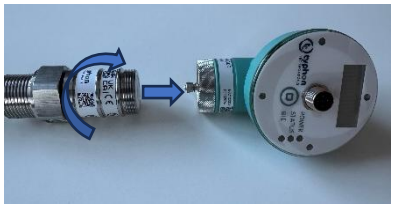
If Standpipe is not in vertical position, a re-calibration of the TTLLS-Cable sensor is recommended, by simply use "Set Actual Level" function in the TT SmartConfig App.





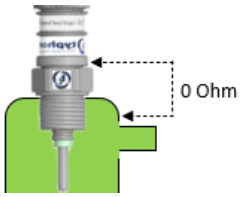
Avoid the inlet pipe sticking inside the standpipe close the to weight, this can cause mechanical short circuit, between the weight and standpipe wall.

1) Unmount the electronic head before installing the mechanical part



2) Mount the mechanical part in the standpipe, ensure correct sealing depending on the type of thread, please refer to the description above for which sealing is recommended.

Always ensure that the thread has an electric connection to the standpipe. This can easily be measured by an ohm meter between the standpipe and the sensor. It should measure 0 ohms.



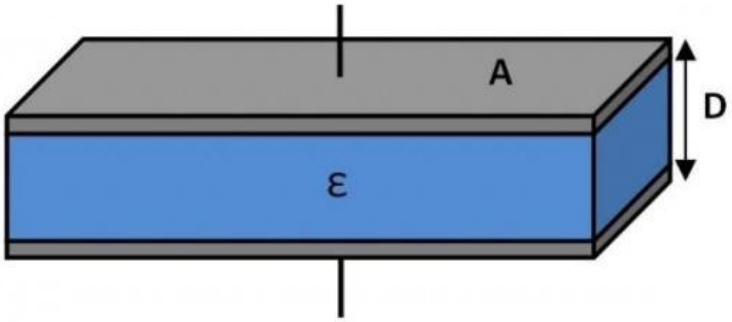
3) After mounting the mechanical part, attached the electronic part, connect the power cable and power on the sensor. Configure the sensor by following the step in section “Simply Sensor Configuration”.

Measuring principle

Capacitive measuring principle

The capacitive measuring principle is based on the working principle of a capacitor. A capacitor creates an electric field between two conductive plates when the voltage is applied.
Capacitance (C) names the ability of a capacitor to accumulate electric charging (depending on the voltage). It is the effect of the combination of the area of overlap (A) on the two plates (in square meters), "d" the separation between the plates (in meters) and "ε" the relative permittivity (dielectric constant) of the material (media).

$$C = \epsilon_0 \, \epsilon_r * \frac{A}{D}$$



Capacitance is proportional to the area of overlap but inversely proportional to the separation between the conducting sheets. The bigger the area of overlap is and the closer the sheets are to each other, the greater the capacitance is.

The distance of the conducting sheets (d) and the size of the plates themselves are always kept constant to a capacitive sensor.

Vacuum: εr = 1; Measuring medium: εr > 1

So the changing of the capacitance is either caused by changing the amount of liquid between the 2 conductive plates or a media with higher relative permittivity replaces the media with a lower relative permittivity.

Safety / Precautions

Every use that is not described in this document is considered incorrect and is not authorized by the manufacturer.

The TTLLS sensor should only be used with approved refrigerant media listed under Product Specifications. Use with other refrigerant media must be validated by Typhon Technologies before installation.

Verify that the installation and operating conditions of the switch respect those specified in this document, especially concerning the supply voltage and environmental conditions.

All service and maintenance operations must be performed by qualified personnel. Installation must comply with local standards and legislation.

Before carrying out any maintenance operations on the switch, disconnect the switch from the main power supply. Before unscrewing the switch from the pipe or tank ensure that the pipe or tank is empty and not under pressure.

Liability for injury or damage caused by incorrect use of the device lies solely with the user. Depending on the application, the metallic part of the switch may be hot or cold.

Certificates

For all industries, electromagnetic compatibility and the Low Voltage Directive apply that electrical and electronic product solutions must be approved as safe products, which cannot cause any harm and danger to people or destroy other equipment with electrical noise. In all products developed by Typhon Technologies we do have approval with relevant test laboratories about which industry-specific directives the safety of the products must comply with before the products are launched in the market.

After safety approval of the products, they receive a CE | UKCA mark as proof that the products comply with the defined requirements for safety, health, and environment within the industry's product area.

Certifications	
Radio	Bluetooth
EMC	EN61000-3
General	CE | UKCA