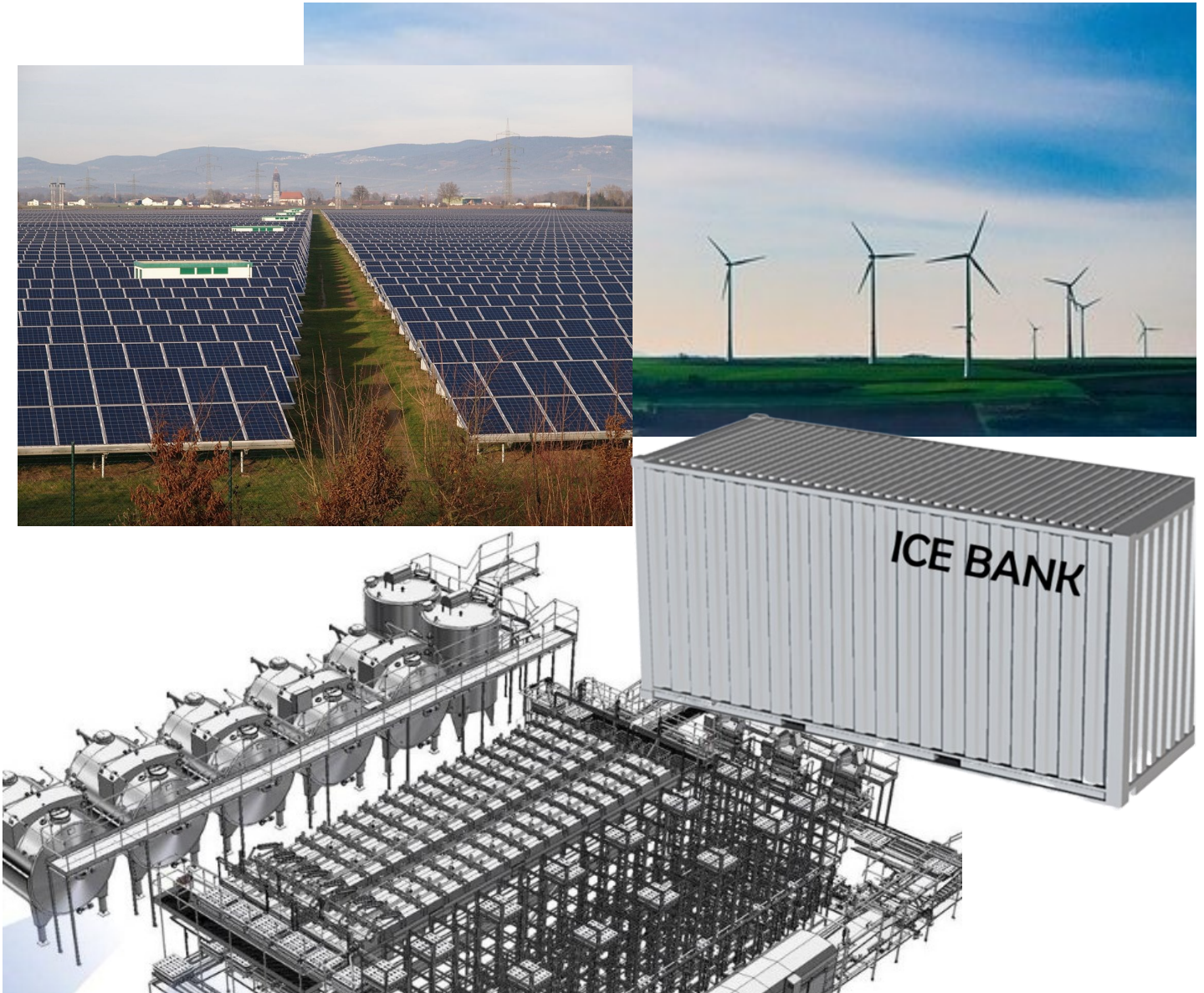


## Ice Bank Sensor



### Ice thickness gauge

Ice banks can reduce the environmental impact by using renewable energy for cooling purposes, and they are used for storing cooling capacity for HVAC or process cooling. One of the great advantages of ice banks are their ability to do time shifting and charge when there is a power surplus or when power cost is low - typically together with solar power. Using an ice bank for process purposes makes it possible to reduce refrigeration system size significantly.

HB products has many years of experience with the development of sensors for measuring ice formation on evaporators and this product is also suitable for measuring the ice thickness in ice banks.

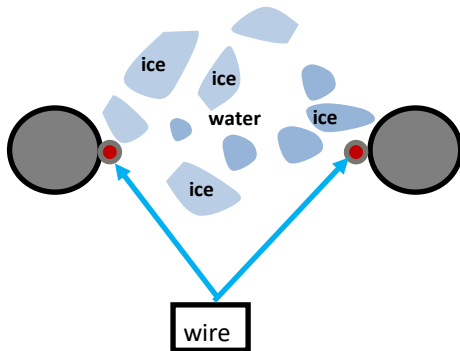
## Ice bank sensors - Ice thickness gauge and water level measurement

### Measuring Ice thickness using the capacitive principle

Ice building can be measured using a capacitive sensor. Ice and water has very different dielectric constants and this can be utilized for measuring the ice thickness between two insulated wires/electrodes, or between a metal part and a wire.

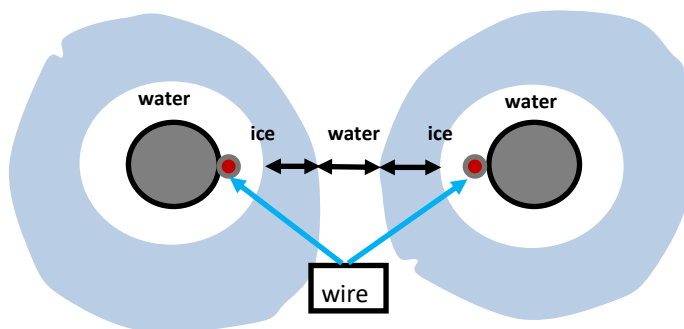
The sensor measures the ice thickness between two wires attached to cooling tubes/evaporator pipes and it is possible to detect a continuous layer. If water connects the two wires the ice is poorly detected - so slurry ice is not detected effectively with wires.

The principle and same sensor is used on conventional air flow evaporators for measuring ice thickness. For this application the information is used for controlling the defrosting.

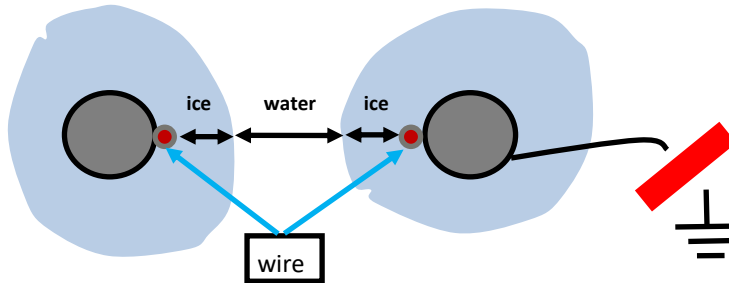


Slurry ice is difficult to detect when using wires because the ice formation is not uniform. Detection of the water level is more attractive for this type of ice.

In ice detection is possible when the buildup is uniform over the cross section as illustrated. The wire used for measuring can be attached to pipes, tubes and other structures - If they are nonconducting

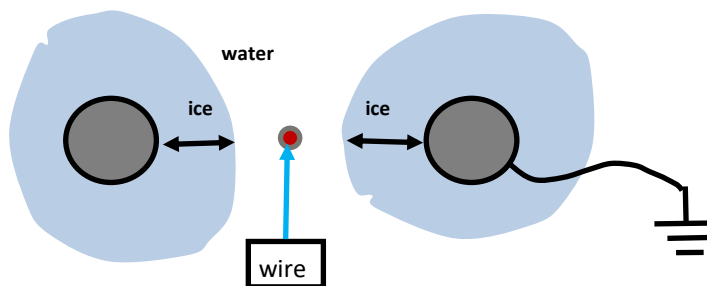


**If the pipes are nonconducting or not grounded the measuring wires can be attached to the cooling pipes**



If the cooling wires are made of plastic the steel wires can be attached to two parallel cooling pipes. If the pipes are disconnected from ground this installation can be used as well. The maximum distance between the wires are 100 mm.

**For grounded metal pipes the measuring wire is mounted between the cooling pipes**



If the cooling wires are made of metal and connected to ground the measuring wire must be installed between the pipes and it can only be attached to a nonconducting structure or a structure not connected to ground.

With the measuring wire installed between the pipes the sensitivity will be better than when using two separate wires because the pipes has a larger surface area

Test results

We have tested the sensor used on evaporators today in a simulated ice bank setup. The test, has been made both internally and by ILK Dresden and show a linear correlation between ice thickness and measured capacitance from 0 to 25 mm. Beyond 25 mm the sensitivity is reduced but the sensor is still able to measure increased ice.

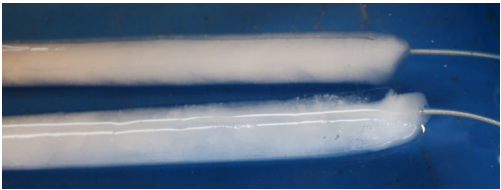
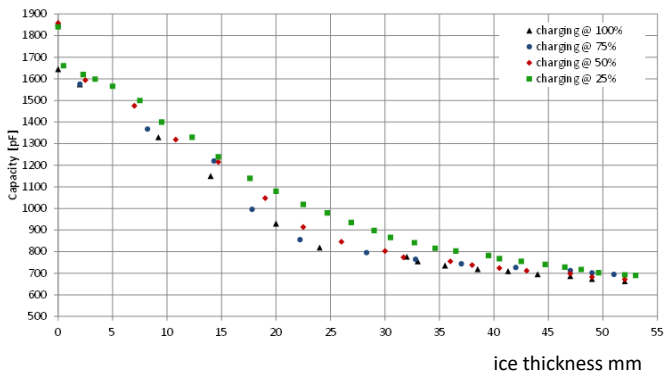
Sensor construction

The sensor consist of two insulated wires both with a length of 1-10 m and a box with an electronic circuit board and a M12 output plug. The box can provide an analog output for a control system or a digital output suitable for a relay. Both the output and the 24 v power supply is via the M12 connector.

Installation

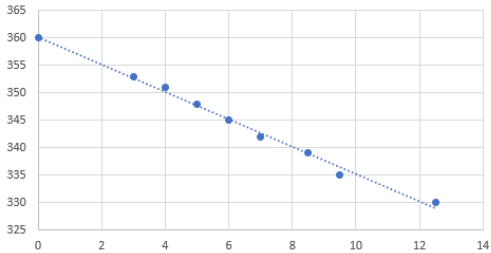
The box is mounted on the ice bank with the two wires going into the water and being attached to pipes or tubes where the ice is formed. The wire has to be mounted with a distance of 30 to 100 mm and the active length has to be at least 1 m long. The accuracy is increased with longer wires. The signal will be an average over the total length.

Measured capacitance for ice thickness



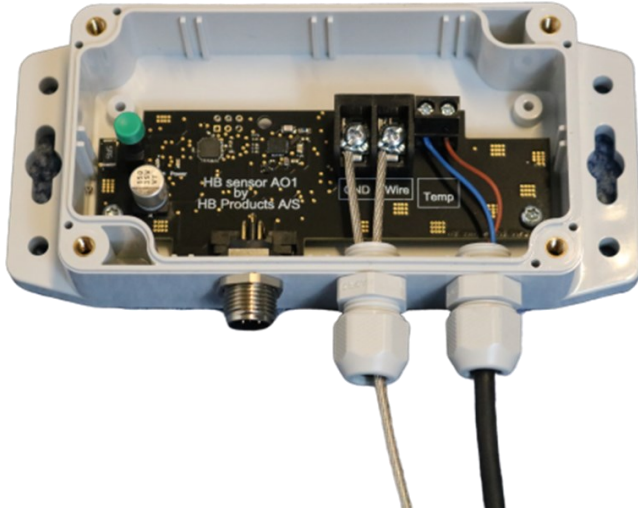
Ice cylinders with sensor wires

Capacitance pF

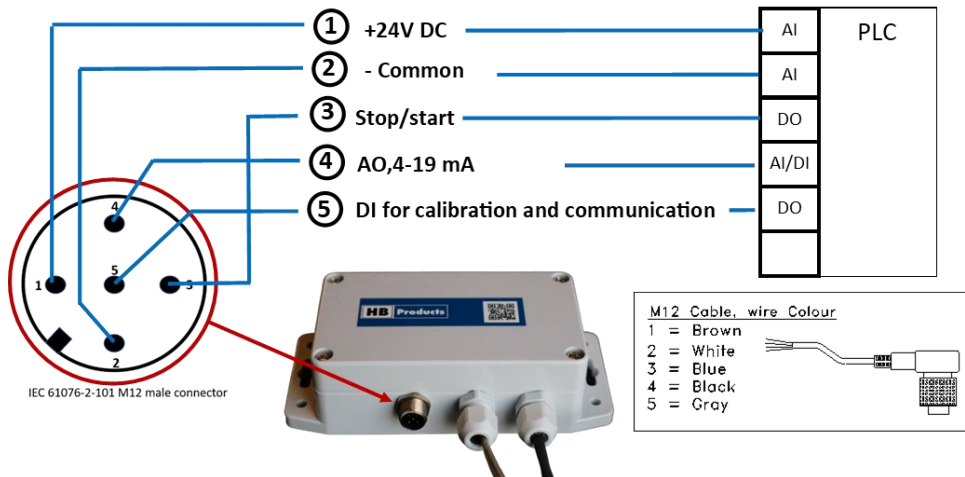


### Wiring the sensor

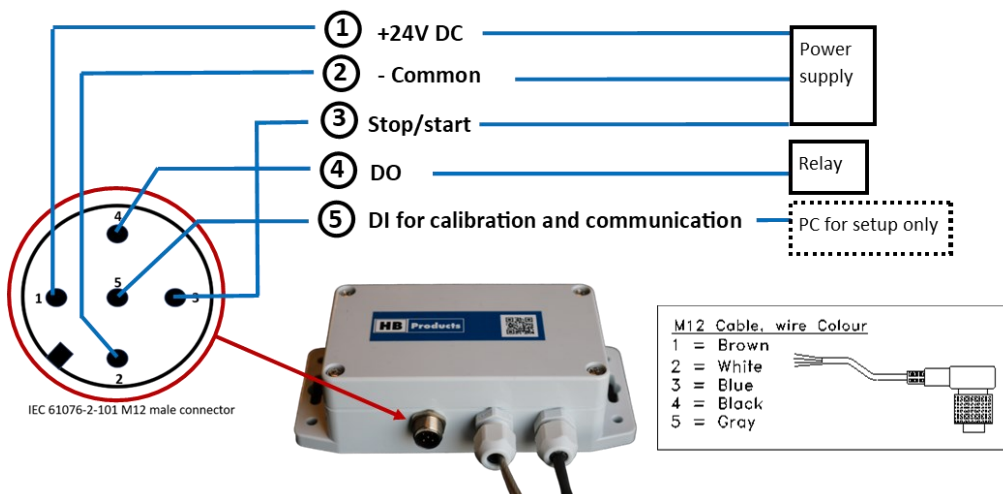
The two wires are mounted in the box. A temperature sensor can be mounted as an option and can be used to trigger an alarm.



### Wiring when using a PLC



### Wiring without a PLC





## Technical specifications

Supply voltage:	24 V AC/DC
Electricity consumption:	250 mA incl. heater
Electrical connection:	Wire terminals
Analog output:	4-20 mA

### Installation conditions:

Ambient temperature:	-30...+50°C
Wire temperature	-30...+90°C
Waterproof rating:	IP65
Vibrations:	IEC 68-2-6 (4g)

### Certifications:

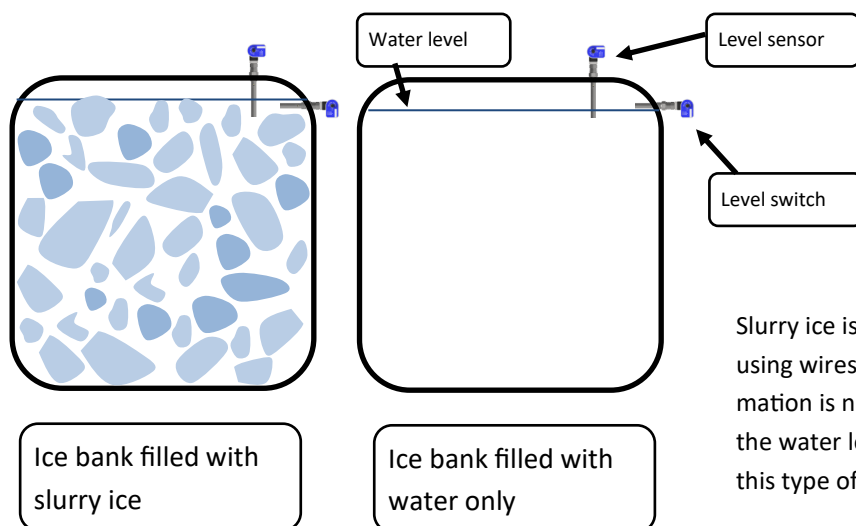
- EMC Emission: EN61000-3-2
- EMC Immunity: EN61000-4-2

### Mechanical specifications:

Materials – mechanical parts:	AISI304 wire
Materials – electronic parts:	Nylon insulation
Cable entry:	PG9 / M12

## Ice measurement using the water level

Ice detection can also be detected indirectly by measuring the water level in the tank. For this application a sensor can measure the level and this solution works with slurry ice as well. For safety a switch can give an alarm when a critical level is reached.



## Standard sensors for water level measurement

The standard sensors are suitable for detecting the water level. More information can be found on [www.hbproducts.dk](http://www.hbproducts.dk).



[www.hbproducts.dk](http://www.hbproducts.dk)



HBLT-A3 –LEVEL SENSOR



HBSR – NH3 & Brine switch