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HOKURIKU ELECTRIC INDUSTRY CO.,LTD.

# Capacitive Humidity Sensor Application Manual

Part number : HSU-CHM-xxx / HSU-CHU-xxx

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## 1. Reflow mounting method

The recommended foot pattern and reflow profile of HSU－CHM are shown in Figures 1-1 and 1-2 respectively.
Although this product is leadless, there are  electrodes on the side so you can confirm the soldering state reliably. Customers should check the mounting condition.
Please conduct the reflow only once. In the case of double-sided mounting, please mount this product on the second mounting surface.

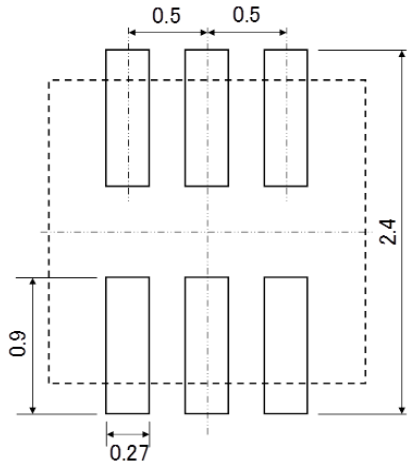
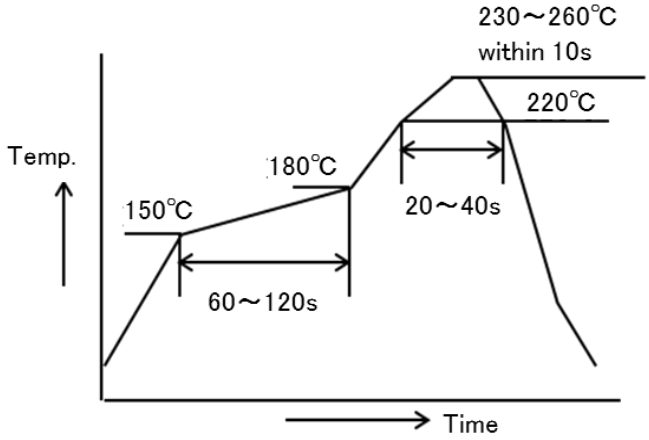



Figure 1-1. Recommended Foot Pattern




※The reflow can be done only once

Figure 1-2. Recommended Reflow Profile

◆Points to remember after reflow mounting

【Humidity】
Due to the high temperature during reflow, the sensor output may shift to a lower level due to excessive drying.
This output shift gradually recovers in a normal temperature environment, and usually recovers in about 2 to 3 days.
However, it may not recover depending on the dry condition and the surrounding environment.
In that case, it can be recovered by performing the following humidification treatment.

Humidification treatment condition : 20～30℃/75～95%RH/24～48 hours

【Temperature】
Stress may be applied due to the high temperature during reflow, and the temperature output may shift.
Therefore, please place it in a place where stress is small and stable.
This shift value varies depending on the reflow conditions and the board, but it will be a constant value under the same conditions, so it is necessary to correct the shift value by reflow.

## ◆Other points to note when mounting

Please do not clean this product with a detergent or an organic solvent etc.

Please do not have the flux etc. adhere to the sensor opening of this product. (See item 2)
Please pay special attention when using a soldering iron especially around this product.

When modifying the soldered part of this product, please do it within 5 seconds at the iron tip temperature of 350 ℃ or less.

Please do not apply mechanical stress to any part of this sensor when mounting or using this sensor.

In temperature measurement, accurate measurement can not be performed
if there are heat-generating components in the surroundings.
Also in humidity measurement, the measured value changes due to the influence of the temperature caused by heat-generating parts.
Please pay attention to the board design and case design to reduce these effects.

## 2. Influence of chemical substances such as solvents, dirt and foreign matters.

This product is a very precise environment measurement part.
Unlike ordinary electronic parts, there are openings for exposing the moisture-sensitive membrane to the outside atmosphere, so it is easy to be affected by chemical contamination.
Although there is no problem in using it in a general environment, please pay attention to the following contents during the storage and manufacture.

### 2-1. Influence of organic solvents

Sensors exposed to vapors of organic solvents such as acetone, ethanol, isopropyl alcohol (IPA) and toluene can cause output drift.
In most cases, the drifted output will not recover naturally.
Even in such a case, it may be possible to restore the original output by performing the following processes in the order of ① and ②.

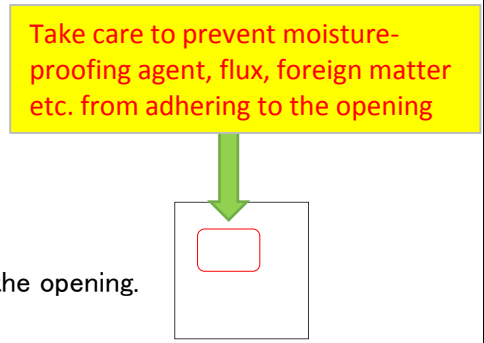
①(Drying treatment) : 100～105℃/Less than 5% RH/10～12 hours
②(Humidification treatment) : 20～30℃ / 75～95%RH/24～48hours

**※Prohibition of cleaning**

To ensure the function of this product, never wash it with an organic solvent.

### 2-2. Influence of moistureproof agents

In general, organic solvents are also contained in moisture-proofing agents.
Please apply ventilation with fresh air sufficiently when applying moisture-proof agent to the soldered part of this product and its surroundings.
Also, please do not have the moisture-proof agent adhere to the opening.
Observing the above precautions, our company has confirmed that there is no influence of the following moisture-proof agent.




HumiSeal (1B51NS)　AR BROWN

### 2-3. Influence of the flux

If the flux adheres to the sensor surface of the opening, the sensor output drift may be caused.
Please note using a solder of non-cleaning type, so that there is no adhesion due to the flux smoke or scattering.

2-4. Influence of foreign matters

When sebum, oil, conductive substance or dielectric substance adheres to the sensor surface of the opening, sensor output drift may be caused.
There is no problem with dust in the general environment.
We have confirmed that there is no problem in the dust test according to JIS D-0207-F3.

2-5. Influence of alkali and acid

When exposed to acids (hydrochloric acid, sulfuric acid, nitric acid, etc.) and alkalis, the output of this sensor will be affected.
In particular, for the ammonia atmosphere, it damages the moisture-sensitive film of this sensor and has a significant effect on the output.
Also, if this sensor comes into contact with high-concentration ozone, hydrogen peroxide, or corrosive gas (sulfurous acid gas, hydrogen sulfide gas, etc.), it may have a significant effect on the output as well.

## 3. Handling Precautions

3-1. ESD (electrostatic discharge) notes
This product must be protected from ESD.
When handling, please implement the following protection measures.

＜Examples＞
・When working, attach a grounded wrist strap.
・Make the floor of the work place a conductive material and ground it.
・Do not place this product in an environment where static electricity is likely to occur.
（Installation of shelves, elimination of insulators, etc.）

Please do ESD protective packaging outside an ESD protection area to protect our sensor.

The electrostatic withstand voltage specifications of this product are the following specifications.
HBM method：±1000V
MM method：±200V

3-2. Notes on radiant energy

This product is not radiation resistant design.
When excessive radiation is irradiated on the product, the performance may be affected.
Please use this product with sufficient attention to the surrounding environment.

3-3. Usage notes

This product is intended to be used for general electrical equipment.
Please contact us in advance when this product is used for extremely high reliability demanding applications, such as medical equipment, safety devices, aerospace instruments, nuclear energy control instruments, combustion control apparatuses etc. whose failure and/or malfunction could do serious damage to human life, body, property and so on whether directly or indirectly.

3-4. Storage condition

Please store this product under the following conditions.

Unopened package state ：Within 1year at 5～35℃/≦60%RH
After the packaging is opened ：MSL1

## 4. About sensor specification

4-1. Accuracy of humidity and temperature

The accuracy described in the specifications of this product is specified by the standard deviation σ with respect to the normal distribution.
Regarding the standard accuracy tolerance at a certain measurement point, 95% of all products within the maximum accuracy are within the range of ± 2σ (σ: standard deviation).

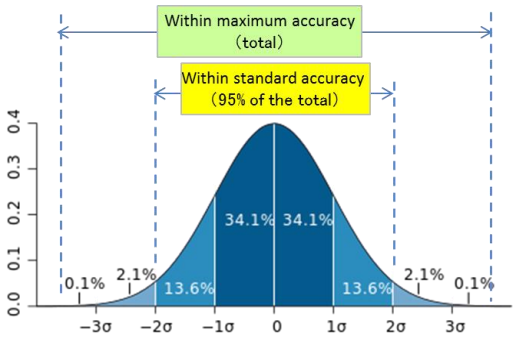



Figure4-1. Precision distribution

4-2. Current consumption

Consumption current is a total of sleep current, standby current, temperature detection current, and humidity detection current.
(See Figure 4-2. Temperature and Humidity Measurement Timing Chart)
The average current consumption (Iavg 1) in the once-per-second measurement is calculated as follows.

Iavg1 = Islp + ( Ist * Tst + It * Tt + Ih * Th ) / 1000

Sleep current :Islp (μA)
Standby current:Ist (μA)
Standby time:Tst (ms)
Temperature detection current:It (μA)
Temperature detection time:Tt (ms)
Humidity detection current:Ih (μA)
Humidity detection time:Th (ms)

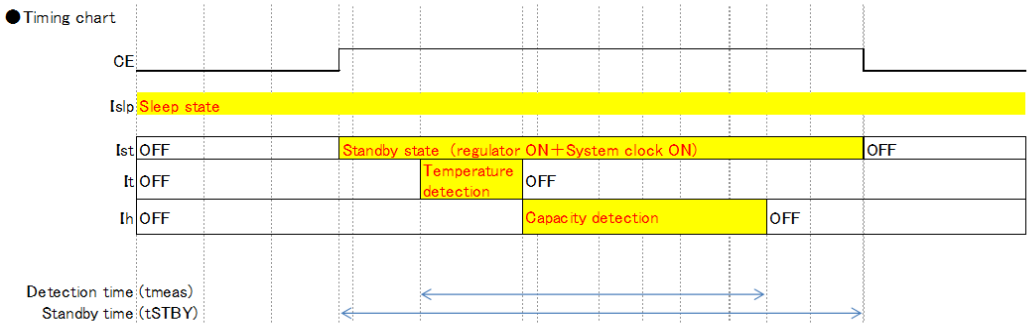



Figure 4-2. Temperature and Humidity Measurement Timing Chart

4-3. Response time

The responsiveness when the humidity changes suddenly approaches the final output value exponentially.
The response time is defined as the time until the humidity change value changes by 63.2% as shown in Fig. 4-3.

<Example. When there is a sudden change from
10% RH to 90% RH>

(90-10) * 0.632 + 10 = 60.6% RH
The response time is the time it takes for the output to reach.

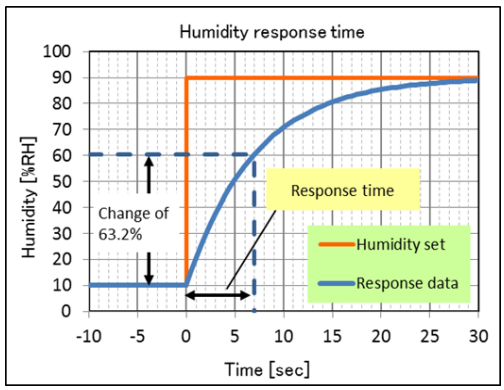



Figure4-3. Response time definition

4-4. Hysteresis

In the humidity measurement by this product,
A slight Difference occurs between the measured at the time of humidification and the measured value at the time of dehumidification.
The output is minus at the time of humidification and plus at the time of dehumidification.to the the average of the measured values at the time of humidification and those at the time of dehumidification.The output value difference from this average value is defined as hysteresis.
(See Figure 4-4)

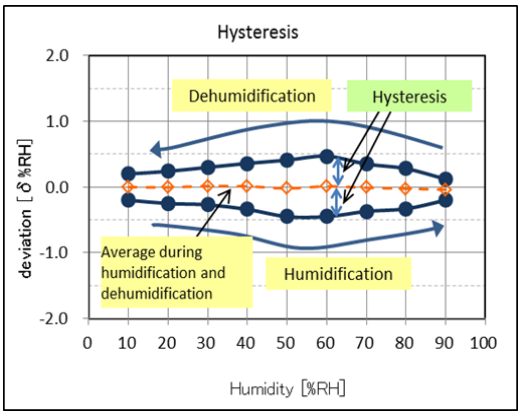



図4-4. Definition of hysteresis

4-5. Long term drift

The aged deterioration of this product is calculated based on the concept of accelerated test below.
Acceleration factor A ＝ exp (Ea/K × (1/T1 − 1/T2))

Ea：Activation energy [eV]
K：Boltzmann constant 8.63×10-5 [eV/K]
T1：Operating temperature[K]
T2：Test temperature[K]

※On acceleration factor

Used parts for this product are an IC and sensor elements, apply activation energy (Ea) = 0.6 of the part to Arrhenius's law.
Incidentally we have not had much experience with the humidity sensor elements, and we have assumed 0.6 as activation energy that is generally assumed.

According to the concept of the accelerated test, the test at 125 ℃ for 1000 h or 85 ℃ for 1000 h corresponds to 15.9 years or 5.7 years when left at 25℃.
The changes per year calculated from these test results are considered as long-term drift

## 5. Board design and case design

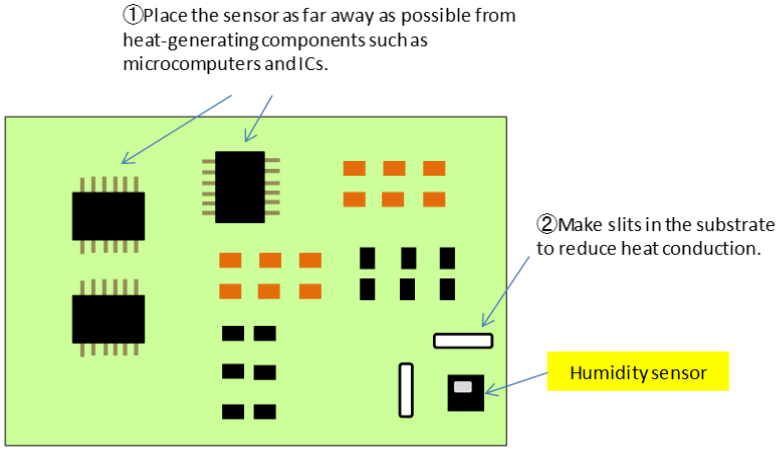
In temperature measurement, accurate measurement can not be performed if there are heat-generating components in the surroundings.
Also in humidity measurement, the measured value changes due to the influence of the temperature caused by heat-generating parts.
This is because saturated water vapor pressure changes with temperature.
When the sensor surroundings rise in temperature due to heat generation, the measured humidity value will be lower by about 2 to 6% RH per 1℃.
In addition, since the temperature rise due to heat-generating components also varies depending on the surrounding wind speed, the temperature measurement value and the humidity measurement value will change.

In order to reduce these effects, please pay attention to the following contents in board design / case design.

■Board design

①Keep this sensor as far away as possible from heating components such as microcomputers and ICs.

②Make slits the the substrate to reduce the heat conduction. →See Figure 5-1




※If the temperature around the sensor rises due to heat generation, humidity measurement will be lower by about 2 to 6% RH per 1℃.

図5-1. Points to keep in mind when designing printed circuit boards

■Case design

①Make barriers in the case and reduce the influence from heat-generating parts.

②Considering the flow of the wind, improve the ventilation to the sensor.

→See Figure 5-2

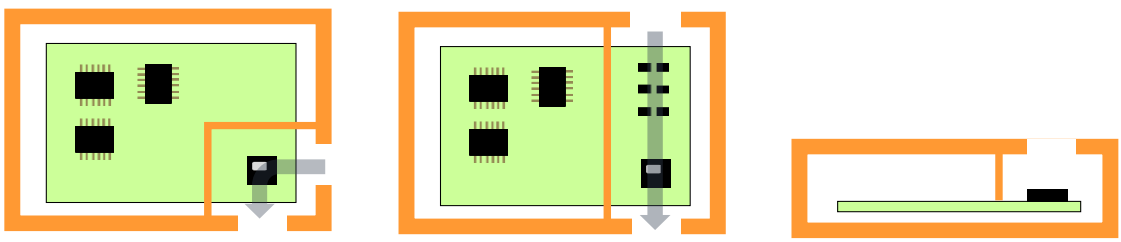


図5-2. Points to keep in mind when designing a case