We created mSense for your Comfort and Energy Saving
to deliver the best Thermal Wellbeing™ in your home
mSense: a new generation of room comfort sensors

In the past, typical room thermostats only provided air temperature as the sole index of thermal conditions in your home. An HVAC control system based uniquely on air temperature does not account for other key comfort elements, such as mean radiant temperature, air temperature and velocity, humidity and air quality.

This is why at Messana we have invented mSense, a new generation of room sensors to enhance comfort and energy efficiency.

mSense measures the three fundamental indoor environmental parameters that influence the wellbeing and thermal conditions of occupants: operative temperature, relative humidity (dew-point) and air quality.

Operative Temperature.

mSense measures the operative temperature by combining the influence of air and mean radiant temperature in a similar way as the skin’s thermal receptors of human body do. Integrating in a control system a sensor that is also influenced by the thermal radiation provides more accurate results than air temperature alone.

Relative Humidity (dew-point).

Measuring and controlling humidity levels in buildings is very important for both comfort and health. It is also crucial in properly controlling radiant cooling systems. mSense is equipped with a stable and accurate sensor to measure humidity and dry bulb temperature. Based on these measurements it precisely evaluated the dew-point temperature.

Air Quality.

As an offered option, mSense can be equipped with a sophisticated gas sensor that goes beyond the carbon dioxide (CO₂) by analyzing substances that directly affect your health and help improve the indoor air quality and save energy. The Indoor Air Quality IAQ sensor monitors the equivalent CO₂ and the Total Volatile Organic Compounds (TVOCs).
Smart radiant cooling and heating in your home

Operative Temperature
Operative temperature is the combined effects of the mean radiant temperature and air temperature. When it comes to thermal comfort, the operative temperature expresses what humans thermally experience in a space. It is a sort of measure of the body’s response to the convective and radiant energy exchange.

Dew-point temperature
The dew-point temperature is an important measurement of the content of moisture in the air. An accurate reading is fundamental to properly control hydronic radiant cooling systems. It dictates the water supply temperature preventing any potential condensation on the radiant surface.

Serial Connection
mSense is based on a standard two-wire RS485 serial connection and is compatible with Modbus and BACnet communication protocols. The physical strength of the RS485 provides robust and reliable connectivity in the most challenging environments.

O-in™ Mount Technology
mSense O-in™ mounting technology allows quick and easy installation by simply pushing the sensor into the wall adapter. The securing of the sensor is simply achieved by friction between the rubber o-ring and the metal O-in™ drywall adapter sleeve.

Paintable Surface
mSense is available in a white matte high quality plastic polymer that can be painted to match your wall color. Architects and designers have freedom to develop their vision without having to incorporate large, unsightly thermostats that detract from the beauty of a space.

Air Quality
Volatile Organic Compounds are toxic chemicals that can be dangerous even at low concentrations and can have health effects. Most notably, Formaldehyde has been proven as carcinogenic. mSense measures the Total VOCs level and allows the control system to activate the air renewal process.
Operative temperature: more than just air temperature

The room temperature sensor is the first element of a heating and cooling control system. It is a fundamental element to achieve the quality of control, and ultimately the comfort experienced in the building.

When evaluating the thermal comfort of a space, it is important not to focus solely on dry-bulb air temperature. There are other key factors to consider: the mean radiant temperature (MRT), the air temperature and velocity, and the humidity.

To achieve the best thermal comfort results, it is necessary to control the room temperature as a function of the operative temperature.

The operative temperature accounts for the effects of both air and mean radiant temperatures. While air temperature is commonly used, mSense accounts also for the thermal radiation in a room.

The mSense embedded operative temperature sensor is influenced by radiant and convective heat exchange, in a similar way as a person. In fact, the human body has temperature receptors within the skin that sense both thermal radiation and airflow. mSense is equipped with a metal half-sphere (or a flat capsule, depending on the model) that works in a similar way as a globe thermometer.

Typical room thermostats only provide dry-bulb air temperature as the sole index of the thermal conditions of the space. Unfortunately, the focus on air temperature has led to poor indoor climate solutions limited to blowing hot and cold air instead of focusing on the mean radiant temperature.

Operative temperature is what humans perceive thermally in a space. Basically, it is a simplified measure of the Thermal Wellbeing™.

People typically respond to thermal discomfort by continuously readjusting their thermostat. The problem is that an air based thermostat never represents the real human thermal exchange. mSense comfort sensor is an essential element of a climate control system especially in presence of radiant ceiling panels but also in conventional radiant floor and air systems.

Integrate mSense in your control system to deliver more accurate results and to achieve optimal comfort performance.

Note 1

mSense is available with two different radiant temperature globe terminals: flat and dome. The flat terminal is the preferred by architects since it presents less interference with the beauty of the space. The dome option, because of its rounded shape, provides higher sensitivity to the radiant heat from the environment.
Humidity: an essential element for your comfort and health

What is the difference between dew-point and relative humidity?

Meteorologists rarely talk about relative humidity (RH). Instead, they tend to use the term “dew-point” temperatures.

Why? Both are measures of the water content of the air:

- Dew-point is the temperature at which the air can no longer hold moisture, and condensate in dew.
- Relative humidity is the amount of moisture in the air at a certain temperature.

If the dew-point is 60°F, and the air temperature drops below 60°F, you will see fog or dew. If you get a bottle out of the fridge with a surface temperature of 55°F and if the dew-point of the air is below 55°F, drops of condensation will form on the bottle.

Humidity hinges on the word “relative”; it is relative to the temperature. When a relative humidity is given, it should also be related to the air temperature. For example: “RH 50% at 72°F”.

Examples:

- Let’s assume a constant dew-point of 70°F, on a summer day when the air temperature is 90°F. In this case, the relative humidity is “just” at 52%. That seems almost comfortable, but if you walked out there you might be sweating.
- On the other hand, in the winter you could have a 45°F day with a dew-point of 40°F, and in this case the relative humidity would be “very high” at 81%. However if you stepped outside it wouldn’t feel so humid. It’s feels just cold.

Under the same condition of moisture content, for example a dew-point temperature at 55°F (optimal comfort condition), you could have different relative humidity, depending on the air temperature.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Relative humidity under a given dew-point temperature of 55°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>80°F</td>
<td>42%</td>
</tr>
<tr>
<td>75°F</td>
<td>50%</td>
</tr>
<tr>
<td>70°F</td>
<td>60%</td>
</tr>
<tr>
<td>55°F</td>
<td>100% (when dew-point and temperature are the same, RH is 100%)</td>
</tr>
</tbody>
</table>

This is why the dew-point is a more representative expression of water content and meteorologists prefer the consistent message that comes with it.

Optimal moisture conditions

<table>
<thead>
<tr>
<th>Dew-point</th>
<th>How would you feel?</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50°F</td>
<td>☹️ too dry</td>
</tr>
<tr>
<td>50-60°F</td>
<td>😊 optimal condition, most of the people feel comfortable</td>
</tr>
<tr>
<td>61-70°F</td>
<td>☹️ uncomfortable</td>
</tr>
<tr>
<td>&gt;70°F</td>
<td>😞 very uncomfortable, too muggy</td>
</tr>
</tbody>
</table>

Why is the dew-point so important in a hydronic radiant cooling system?

In a radiant cooling system, each conditioned room of a building requires an accurate reading of the dew-point (±2°F). Based on the dew-point temperature, the radiant cooling control system adjusts the water supply temperature in order to prevent the ceiling surface temperature to go below the room dew-point temperature and avoid condensation.

The same apply for radiant floors.

The effect of humidity on human body.

Research indicates that for health and comfort, a relative indoor humidity of 40% to 60% (with temperature in the 70s) is desirable. This means a dew-point temperature between 50°F and 60°F.

In general humidity is directly related to the amount of allergens in the indoor environment, and should be controlled. Humidity also effects the thermal comfort: the higher humidity, the higher the temperature actually feels. Also, low humidity can have negative effects on the human body: excessive body loss of water can affect the skin and the respiratory system.

mSense is a fundamental element of a radiant cooling system to keep always the moisture under control.
Smart Indoor Air Quality for better health and energy efficiency

People spend 90% of their time indoors where concentrations of pollutants are significantly higher than outdoors. The widespread use of new building materials and improved insulation technology, has resulted in increased concentrations of volatile organic compounds (VOCs). These VOCs originate mainly from paints and solvents, carpets and furniture, and can also be emitted by humans. Elevated VOC levels can have a negative impact on well being and comfort.

Messana mSense integrates an innovative air quality sensor that constantly monitors the Total VOC and the equivalent CO2. This allows to increase the efficiency of the ventilation and air purification to improve the indoor air quality and the Thermal Wellbeing™ experience.

What is in the air that we breathe?

Clean air simply comprises of 21% oxygen and 79% nitrogen. However, in real life and in particular indoors, this looks rather different. Various additional components, such as noble gases, carbon monoxide (CO), carbon dioxide (CO2), and volatile organic compounds (VOCs) are found in the air that we breathe. In particular, the latter two are the most important one. CO2, due to its HVAC industry awareness level and VOCs, due to their criticality.

The role and impact of VOCs in indoor air

About 5,000 to 10,000 different VOCs exist. They are two to five times more likely to be found indoors than outdoors. Indoor VOCs are various types of hydrocarbons from mainly two sources: bio-effluents, i.e. odors from human respiration, transpiration, and metabolism and building material as well as furniture. VOCs are known to cause eye irritations, headache, drowsiness or, even dizziness, all summarized under the term SBS (sick building syndrome). VOCs are the one and only root cause for the need to ventilate! Some typical indoor contaminants and their sources are shown in the table below in which VOCs caused by humans have the lion's share over building material, furniture, and office equipment, hence rule the demand for ventilation.

<table>
<thead>
<tr>
<th>Typical indoor air contaminants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contamination Source</td>
</tr>
<tr>
<td>Human Being</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

Intelligent air quality sensor that goes beyond CO2

Although CO2 plays a major role in modern ventilation control systems, sole CO2 has not a real impairment on humans. As decades of submarine experience and ISS (International Space Station) experiments confirm: even heavy CO2 concentrations of 1% (10,000 ppm) show no impact on our wellbeing. Nonetheless, due to the lack of suitable VOC sensing devices, historically CO2 values have served as adequate air quality indicator, reflecting the total amount of VOCs (TVOCs) since the amount of CO2 is proportional to the amount of VOCs, produced by human respiration and transpiration. At least in average, as shown in the graph below.

Therefore the ease of reduction to one single parameter, compared to consideration of some 1,000s VOCs, and the availability of suitable CO2 measuring technology made it the surrogate of inhabitant generated pollution in confined living spaces i.e. today’s standard indoor air quality reference for DCV with tangible air quality definitions (right table) as initially introduced by Maxvon Pettenkofer and picked up by most HVAC industry standards.

<table>
<thead>
<tr>
<th>CO2 [ppm]</th>
<th>Air Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>2100</td>
<td>bad</td>
</tr>
<tr>
<td>2000</td>
<td>heavily contaminated indoor air ventilation required</td>
</tr>
<tr>
<td>1900</td>
<td>mediocre</td>
</tr>
<tr>
<td>1800</td>
<td>contaminated indoor air ventilation recommended</td>
</tr>
<tr>
<td>1700</td>
<td>fair</td>
</tr>
<tr>
<td>1600</td>
<td>good</td>
</tr>
<tr>
<td>1500</td>
<td>excellent</td>
</tr>
<tr>
<td>1400</td>
<td></td>
</tr>
<tr>
<td>1300</td>
<td></td>
</tr>
<tr>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>1100</td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td></td>
</tr>
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<td>900</td>
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<td>800</td>
<td></td>
</tr>
<tr>
<td>700</td>
<td></td>
</tr>
<tr>
<td>600</td>
<td></td>
</tr>
<tr>
<td>500</td>
<td></td>
</tr>
<tr>
<td>400</td>
<td></td>
</tr>
</tbody>
</table>

CO2 and VOCs from business meeting session

VOC events not captured by CO2 sensors Window open Window close Cigarette smoke
**Technical specifications**

### Sensors

**Operative Temperature**

- **Sensor**: Sensirion STS30
- **Typical accuracy**: ±0.166°F (±0.3°C)
- **Operative temperature range**: -40 to +257°F (-40 to +125°C)

**Dry Bulb Air Temperature (DB) and Relative Humidity (RH)**

- **Sensor**: Sensirion SHT35
- **DB temperature accuracy**:
  - 68°F to 140°F (20°C to 60°C): ±0.18°F (±0.1°C)
  - 32°F to 68°F (0°C to 20°C): ±0.36°F (±0.2°C)
- **DB temperature sensor long term drift**: <0.054°F/yr (0.03°C/yr)
- **DB temperature operating temperature range**: -40 to +257°F (-40 to +125°C)
- **RH accuracy**: ±1.5%
- **RH sensor long term drift**: <0.25%/yr
- **RH operating range**: 0% - 100% RH

**Dew-point temperature**

- **Dew-point temp. is evaluated from RH and DB temp.**: Magnus formula
- **Dew-point accuracy**:
  - 74°F @40% RH (23°C @40% RH): ±1.35°F (±0.75°C)
  - 74°F @50% RH (23°C @50% RH): ±1.2°F (±0.67°C)
  - 74°F @60% RH (23°C @60% RH): ±1.1°F (±0.61°C)

**Digital gas sensor for monitoring indoor air quality**

- **Sensor**: AMS CCS811
- **Volatile Organic Compounds (VOC) detected**:
  - Alcohols, Aldehydes, Ketones, Organic Acids, Amines, Aliphatic and Aromatic Hydrocarbons

### Size and weight

- **Size**: 3 1/2 inches (90 mm) x 1 3/4 inches (45 mm)
- **Weight**: 2 ounces (57 grams)

**Mounting type**

- O-in™ mounting technology (requires 2-inch hole drywall cut out)

**User interaction**

- App or web interface

**Programming**

- Dip switch, Near Field Communication (NFC), serial bus RS485 (Modbus or BACnet)

**Color and finish**

- Arctic white paintable plastic

**Environmental requirements**

- **Operating ambient temperature**: 32° to 120°F (0° to 50°C)
- **Relative humidity**: 0% to 100%
- **Operating altitude**: up to 10,000 feet (3,000 m)

**In the box**

- mSense, documentation. Installation kit to be ordered separately.

**Lifetime**

- Expected sensor lifetime is 10 years or more, in normal RH and temperature operating range. Over the years the accuracy of integrated sensors will decrease based on the long term drift.

**Notes**

1. App and Web Interface are available only with a Messana home climate control system.
2. Modbus or BACnet protocols can be selected via dip-switch (#9). BACnet will be available late in 2017.
3. Related to the embedded sensor, not to the mSense itself. See also “Environmental requirements”.
4. Size, weights and technical characteristics may vary without prior notice.

**Input power**

- **24 V AC/DC (±15%)**: 0.6VA / 0.4W
Installation Guide

in the most simple way
mSense Installation Guide

In the box

- mSense
- mSense Installation Guide

Installation kit (sold separately)

- O-in™ drywall adapter sleeve
- Mudding / Painting O-in™ protection cap
- mSense plug connector
- O-in™ insertion tool (use with adapter sleeve)

⚠️ mSense sensors should be installed by a professional.
Installation and positioning guidelines

mSense is the “eye” of the control system. In order to “see” the thermal radiations of the room the sensor must have an unobstructed view. An incorrect positioning of the sensor will prevent the heating and cooling system from delivering the best thermal comfort.

- mSense should be installed from 5ft to 7ft from the floor.
- Choose an internal wall and a central location and avoid direct exposition to sunlight and air drafts.
- Avoid locations where the sensor can be covered by furniture, doors, draperies and clothing.
- It must always be installed away from any equipment that could generate heat, cold and humidity.

Before drywall is installed, run two wires in a daisy chain configuration through the studs. Staple the wires to a wall stud (5 to 7 feet) above the floor and coil 1 foot of the wire within the wall cavity. Mark the location of the wires in order to be able to locate them after the drywall is installed. This method requires locating the wire in the wall cavity after dry walling has been completed.

A preferred method is to mount a 16x16 square of sheet rock along with the metal sleeve and sheet rock the rest of the room later.

Drywall cut out (2-inch)

Attach a drywall patch (16”x10” recommended size) between the studs (be careful to center it from 5 to 7ft from the finished floor).

Using a drill and a 2” hole saw cut a round hole in the drywall patch and proceed with the installation of the O-in™ adapter sleeve as shown in the section “O-in™ adapter sleeve installation sequence”.

If the sensor is mounted over a Messana mPad or a regular wall switch or receptacle, pay attention to the alignment with the mSense sensor.

When cutting the 2” hole pay attention to pipes and or wires behind the drywall patch.
Pass the cables inside the O-in™ adapter sleeve and insert them inside the O-in™ installation tool. Fix the O-in™ adapter sleeve through the little slots into the O-in™ installation tool (the threaded part goes toward the tool).

1. Push the O-in™ adapter sleeve into the wall up to the start of the threads.
2. Push the O-in™ installation housing against the drywall in order to maintain a perpendicular position.
3. Firmly hold the O-in™ installation housing against the drywall surface in order to maintain the tool’s perpendicularity. Push and rotate in a clockwise direction until the O-in™ installation tool adapter sleeve is completely screwed into the drywall. Remove the installation tool.
Wiring the 4-pole connector

The two 2-pair twisted cables must be connected together into the 4-pole connector to maintain a daisy chain connection. Using a wire-stripping tool strip all stranded wire about 1/4 inch from the end. Couple the wires with same color and line up their ends, then twist the terminals together. Insert the 4 couples into the 4-pole connector following the label and tighten the screws.

Before wiring the mSense sensor, make sure to set the communication parameters (serial address, termination and protocol) through the dip-switch. See section "Dip-switch configurations".

In case of first or end terminal of the daisy chain there will be only one cable to be wired. Follow the same wiring instruction.

Insert the plug connector into the O-in™ protection cap.

Push the mudding / painting O-in™ protection cap into the sleeve.

The plastic protection cap holds the wired connector in place and protects it from dust and debris during all the construction phases.

Pulling the cable into the building:

The cable should be pulled through the opening or the duct. Pull it with a pulling head. Before the entry, the cable ends must be protected from dust and damage.

Pulling the cable into the building:

The cable should be pulled through the opening or the duct. Pull it with a pulling head. Before the entry, the cable ends must be protected from dust and damage.

Cable specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>Communication and control cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 1</td>
<td>22 AWG twisted pair foil shielded, 24 AWG drain wire (data) - 18 AWG pair (power)</td>
</tr>
<tr>
<td>Option 2</td>
<td>22 AWG 2-pair twisted, individually foil shielded, 24 AWG drain wire</td>
</tr>
<tr>
<td>Option 3</td>
<td>22 AWG 2-pair twisted</td>
</tr>
</tbody>
</table>

Approved cables

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Code</th>
<th>Pair Color</th>
<th>24V</th>
<th>0</th>
<th>D+</th>
<th>D-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha Wire</td>
<td>1317C</td>
<td>red &amp; black / white &amp; black</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Belden</td>
<td>2466C</td>
<td>red &amp; black / white &amp; green</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>General Cable</td>
<td>C1342A</td>
<td>red &amp; black / white &amp; green</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>General Cable</td>
<td>C6010A</td>
<td>red &amp; black / white &amp; black</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Setting the mSense address

A Modbus RS-485 network comprises of one Master device (e.g. Messana mZone zoning module) and up to 247 Slave devices (e.g. mSense sensors). A Slave device can communicate on the bus only if requested by the Master.

Therefore, a typical Modbus (or BACnet) transaction involves the Master, who is in charge of controlling the bus, and one Slave device at a time. Additionally, the Master can also broadcast messages to all the Slaves.

In order to identify the recipient of the message, the first character is a byte that contains the numeric address of the designated Slave. It is of the utmost importance that each Slave device must be configured with a unique numeric address. Eligible addresses are 1 through 247.

<table>
<thead>
<tr>
<th>Address 0 cannot be assigned to a Slave.</th>
</tr>
</thead>
</table>

The Slave address must be manually configured through the dip-switch SW1. The dip-switch can be accessed by removing the mSense top cover as shown in the pictures above.

The dip-switch SW1 must be set according to the diagram in the section "Dip-switch configurations".

Dip-switch configurations

mSense address (dip-switch #1 to #8)

Bus termination (dip-switch #0)

Modbus / BACnet protocol selection (dip-switch #9)
To complete the installation of the mSense sensor, remove the O-in™ protection cap from the wall. Use a sharp tool to carefully lift the edge or insert the end of a paper clip and pull it out. Extract the previously wired connector and plug it to the mSense sensor.

Push the mSense into the O-in™ adapter sleeve. Make sure to align the air openings vertically as shown in the picture. During insertion be sure to keep the ventilation holes on the front of the mSense sensor perpendicular to the floor as shown in the picture.

Depending on the wall finishing, to ensure the correct grip of the sensor you may need to move the o-ring.

Even untouched mSense is barely noticeable. To make the sensor even less noticeable mSense can be painted using water based paint in a matte finish only. Oil based or gloss and semi-gloss paint can have an effect on the accuracy of the readings performed by the sensors, so please do not use these products on the sensor face. It is also critical to NOT obscure the openings in the sensor in any way.

Following these parameters will provide a tool that you can barely see but gives you a lot of information.

With mSense, architects and interior designers have the freedom to develop their vision without having to incorporate large, unsightly thermostats that detract from the beauty of a space.
Messana Radiant Cooling typical system wiring diagram

Wiring Legend
- mSense data/power cable (22 AWG 2-pair twisted cable)
- RS485 twisted pair
- Ethernet CAT 5
- DO Digital Outputs
- DI Digital Inputs
- AO Analog Outputs
- AI Analog Inputs

use AWG18 twisted pair unless otherwise specified

mSense ID n
Termination ON

mSense ID n+1
Termination ON

mSense ID n+2
Termination ON

Expansion: mSense (n+m ≤ 12)

max 300ft

max 300ft

max 300ft

mSense ID n
Termination ON

mSense ID n+1
Termination ON

mSense ID n+2
Termination ON

mSense ID m
Termination ON

max 300ft

max 300ft

max 300ft

mSense (n+m ≤ 12)

mSense ID n
Termination ON

mSense ID n+1
Termination ON

mSense ID n+2
Termination ON

mSense ID m
Termination ON

max 300ft

max 300ft

max 300ft

mSense (n+m ≤ 12)

mSense ID n
Termination ON

mSense ID n+1
Termination ON

mSense ID n+2
Termination ON

mSense ID m
Termination ON

max 300ft

max 300ft

max 300ft

mSense (n+m ≤ 12)
mSense can communicate with a control system (e.g. Messana mZone) via Modbus protocol.
The sensor programming and date exchange is based on three set of 16bit registers:

- General settings
- Data register, read only, with temperature in Fahrenheit degree
- Data register, read only, with temperature in Celsius degree

mSense is designed to work with both Fahrenheit and Celsius degrees.

The Modbus registers can be read with the command 0x03 (read holding register) and write with the commands 0x06 (write single register) and 0x10 (write multiple register).

If a value from one of the three sensors (ST30, SHT35 and CCS801) is unavailable, the data register returns 255 (0x00).

### Modbus registers

**16bit registers (General settings)**

<table>
<thead>
<tr>
<th>Address</th>
<th>Description</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
<th>R/W</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>Modbus address</td>
<td>0</td>
<td>255</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>201</td>
<td>Transmission speed</td>
<td>0</td>
<td>5</td>
<td>bits</td>
<td>R/W</td>
</tr>
<tr>
<td>202</td>
<td>Sensor type</td>
<td>16</td>
<td>12</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>203</td>
<td>IAQ sample rate</td>
<td>0</td>
<td>600</td>
<td>sec</td>
<td>R/W</td>
</tr>
<tr>
<td>204</td>
<td>Operate 7 sample rate</td>
<td>0</td>
<td>600</td>
<td>sec</td>
<td>R/W</td>
</tr>
<tr>
<td>205</td>
<td>(4K) sample rate</td>
<td>0</td>
<td>600</td>
<td>sec</td>
<td>R/W</td>
</tr>
<tr>
<td>206</td>
<td>Air temperature</td>
<td>-400</td>
<td>1940</td>
<td>°F x 10</td>
<td>R/W</td>
</tr>
<tr>
<td>207</td>
<td>Operative temperature</td>
<td>-400</td>
<td>1940</td>
<td>°F x 10</td>
<td>R/W</td>
</tr>
<tr>
<td>208</td>
<td>Relative humidity</td>
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<td>1000</td>
<td>%RH x 10</td>
<td>R/W</td>
</tr>
<tr>
<td>209</td>
<td>SW version</td>
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<td>1</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>210</td>
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<td>1</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>211</td>
<td>LED</td>
<td>0</td>
<td>1</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>212</td>
<td>S/N [0-1]</td>
<td>0</td>
<td>0x0F</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>213</td>
<td>S/N [2-3]</td>
<td>0</td>
<td>0x0F</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>214</td>
<td>S/N [4-5]</td>
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<td></td>
<td>R/W</td>
</tr>
<tr>
<td>215</td>
<td>S/N [6-7]</td>
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<td>0x0F</td>
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<td>R/W</td>
</tr>
<tr>
<td>216</td>
<td>S/N [8-9]</td>
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<td>0x0F</td>
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</tr>
<tr>
<td>217</td>
<td>S/N [10-11]</td>
<td>0</td>
<td>0x0F</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>218</td>
<td>SW version</td>
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<td>1</td>
<td></td>
<td>R/W</td>
</tr>
<tr>
<td>219</td>
<td>HW version</td>
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<td>1</td>
<td></td>
<td>R/W</td>
</tr>
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</table>

**16bit registers (Fahrenheit degree)**

<table>
<thead>
<tr>
<th>Address</th>
<th>Description</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
<th>R/W</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>Operation temperature</td>
<td>-400</td>
<td>1940</td>
<td>°F x 10</td>
<td>R</td>
</tr>
<tr>
<td>101</td>
<td>Air temperature</td>
<td>-400</td>
<td>1940</td>
<td>°F x 10</td>
<td>R</td>
</tr>
<tr>
<td>102</td>
<td>Dew-point temperature</td>
<td>-126</td>
<td>1940</td>
<td>°F x 10</td>
<td>R</td>
</tr>
<tr>
<td>103</td>
<td>Relative humidity</td>
<td>0</td>
<td>1000</td>
<td>%RH x 10</td>
<td>R</td>
</tr>
<tr>
<td>104</td>
<td>Equivalent CO2</td>
<td>400</td>
<td>8192</td>
<td>ppm</td>
<td>R</td>
</tr>
<tr>
<td>105</td>
<td>TVOC</td>
<td>0</td>
<td>1187</td>
<td>ppm</td>
<td>R</td>
</tr>
<tr>
<td>106</td>
<td>Raw (μg/m³)</td>
<td>0</td>
<td>63</td>
<td>μg/m³</td>
<td>R</td>
</tr>
</tbody>
</table>

**16bit registers (Celsius degree)**

<table>
<thead>
<tr>
<th>Address</th>
<th>Description</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
<th>R/W</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>Operation temperature</td>
<td>-400</td>
<td>1940</td>
<td>°C x 10</td>
<td>R</td>
</tr>
<tr>
<td>101</td>
<td>Air temperature</td>
<td>-400</td>
<td>1940</td>
<td>°C x 10</td>
<td>R</td>
</tr>
<tr>
<td>102</td>
<td>Dew-point temperature</td>
<td>-126</td>
<td>1940</td>
<td>°C x 10</td>
<td>R</td>
</tr>
<tr>
<td>103</td>
<td>Relative humidity</td>
<td>0</td>
<td>1000</td>
<td>%RH x 10</td>
<td>R</td>
</tr>
<tr>
<td>104</td>
<td>Equivalent CO2</td>
<td>400</td>
<td>8192</td>
<td>ppm</td>
<td>R</td>
</tr>
<tr>
<td>105</td>
<td>TVOC</td>
<td>0</td>
<td>1187</td>
<td>ppm</td>
<td>R</td>
</tr>
<tr>
<td>106</td>
<td>Raw (μg/m³)</td>
<td>0</td>
<td>63</td>
<td>μg/m³</td>
<td>R</td>
</tr>
</tbody>
</table>

Notes:
1. Modbus address can also be set via dip-switch. However, the Modbus or Near Field Communication (NFC) programming overwites the dip-switch setting.
2. A bit of 1 indicates that the same value stored both refer to the same sensor (Sensor ST30-193). The same applies to bit 10 and 11 for the CO2 sensor (CCS801).
3. Depending on the device characteristics and the self-diagnosis capabilities.
Messana offers a unique home climate control platform designed with 20-year experience in hydronic radiant cooling and heating. The Messana control system integrates a unique technology to modulate radiant fluid temperatures so that surfaces stay above the dew-point, while keeping occupants comfortable and boosting energy efficiency.

Explore the latest home climate control technology
Designed by Messana specifically for Radiant Cooling and Heating Systems

mBox
HVAC/Radiant automation and control module

It is the main unit of the home climate control system. Typically installed in the mechanical room, it regulates the home energy flow to deliver optimal Thermal Wellbeing™. It controls energy resources (heat pumps, chillers and boilers) with multi-staging, Domestic Hot Water, Heat Recovery Ventilation based on Indoor Air Quality and Neutral Temperature Dehumidification.

mZone
zoning module (available for 8 or 12 zones)

The mZone module connects up to 12 mSense room sensors. It is installed at manifold location to activate thermal actuators, recirculating pumps, mixing valves, 2-way and 6-way zone valves and air handlers. It is designed for 2-pipe as well as for 4-pipe distribution systems for simultaneous heating and cooling demand. It works also with hybrid radiant/forced-air cooling and heating systems.

Messana App
web and mobile full-system control app

The new Messana web and mobile app gives you full control of the radiant cooling and heating system from anywhere in the world. It features a friendly and intuitive user interface to interact even with the most sophisticated systems at your fingertips.

The Messana app fits seamlessly in your life to provide the perfect Thermal Wellbeing™, precisely when and where you want it.

Warranty Conditions

LIMITED WARRANTY AND PRODUCT RETURN PROCEDURE
The liability of Messana under this warranty is limited.

The Purchaser, by taking receipt of any Messana product (“Product”), acknowledges the terms of the Limited Warranty in effect at the time of such Product’s sale and acknowledges that it has read and understands same.

The Messana Limited Warranty to the Purchaser on the Products sold hereunder is a manufacturer’s pass-through warranty which the Purchaser is authorized to pass through to its customers. Under the Limited Warranty, each Messana Product is warranted against defects in workmanship and materials if the Product is installed and used in compliance with Messana’s instructions, ordinary wear and tear excepted. The pass-through warranty period is for a period of twenty-four (24) months from the production date if the Product is not installed during that period, or twelve (12) months from the documented date of installation if installed within twenty-four (24) months from the production date.

The liability of Messana under the Limited Warranty shall be limited to, at Messana’s sole discretion, the cost of parts and labor provided by Messana to repair defects in materials and/or workmanship of the defective product, or to the exchange of the defective product for a warranty replacement product, or to the granting of credit limited to the original cost of the defective product, and such repair, exchange or credit shall be the sole remedy available from Messana, and, without limiting the foregoing in any way, Messana is not responsible, in contract, tort or strict product liability for any other losses, costs, expenses, inconveniences, or damages, whether direct, indirect, special, exemplary, incidental or consequential, arising from ownership or use of the product, or from defects in workmanship or materials, including any liability for fundamental breach of contract.

The pass-through Limited Warranty applies only to those defective Products returned to Messana during the warranty period. This Limited Warranty does not cover the cost of the parts or labor to remove or transport the defective Product, or to reinstall the repaired or replacement Product, all such costs and expenses being subject to Purchaser’s agreement and warranty with its customers.

Any representations or warranties about the Products made by Purchaser to its customers which are different from or in excess of the Messana Limited Warranty are the Purchaser’s sole responsibility and obligation. Purchaser shall indemnify and hold Messana harmless from and against any and all claims, liabilities and damages of any kind or nature which arise out of or are related to any such representations or warranties by Purchaser to its customers.

The pass-through Limited Warranty does not apply if the returned Product has been damaged by negligence by persons other than Messana, accident, fire, Act of God, abuse or misuse; or has been damaged by modifications, alterations or attachments made subsequent to purchase which have not been authorized by Messana; or if the Product was not installed in compliance with Messana’s instructions and/or the local codes and ordinances; or if due to defective installation of the Product; or if the Product was not used in compliance with Messana’s instructions.

VARIATIONS THAT MIGHT APPLY TO THIS LIMITED WARRANTY
Some jurisdictions do not allow limitations on how long an implied warranty lasts or specific exclusions, so some of the limitations set out above may not apply to you. If any court or relevant authority decides that any of these limitations is unenforceable, it should be deemed modified to the minimum extent necessary to make it enforceable. If this modification is not possible, the relevant provision should be deemed deleted. Any modification or deletion will not affect the validity of the rest of this Limited Warranty.

CONTACT INFORMATION
Please direct any questions about this Limited Warranty to Messana Inc. at the address located at: radiantcooling.com/contact