IMS

1 *Transponder PCB with antenna coil*

2 *Readout of humidity transponder*

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HUMIDITY AND TEMPERATURE TRANSPONDER

Features

- Transponder for the wireless measurement of relative air humidity and temperature
- Passive operation, power supply by RF
- LF frequency range at 133 kHz

The humidity transponder is an RFID transponder with attached humidity and temperature sensors. It is contactless powered by the RF field of a reader unit.

This sensor RFID is especially designed for measurement tasks, where wired connections are not feasible, for example for inspection of heat insulation parts of buildings, hygiene controlling in inaccessible parts of air conditioning systems or quality check of goods in a supply chain. Because of its flat design it can easily be integrated in customers' applications. The humidity transponder can be read out using mobile or stationary reader units. Measurement is initiated by the remote reader unit that wakes up the sensor by applying a RF field.

The sensor electronics perform the measurement of humidity and temperature, assemble a related data packet and transmit this to the reader unit. A wired interface enables the connection of additional sensors and functionalities.

Applications

- Contactless humidity and temperature sensing
- Building inspection and maintenance
- Quality inspection in supply chains
- Identification

Technical Realisation

The humidity transponder consists of several discrete electronic devices, an ultra low power microcontroller, sensors, converters, references, supply voltage control and the analogue front end. Using of the analogue front end the transponder receives power and transmits data to the reader. The measurement procedure and a protocol state machine are implemented by software in the microcontroller. A capacitive polymer sensor is used to measure the humidity.
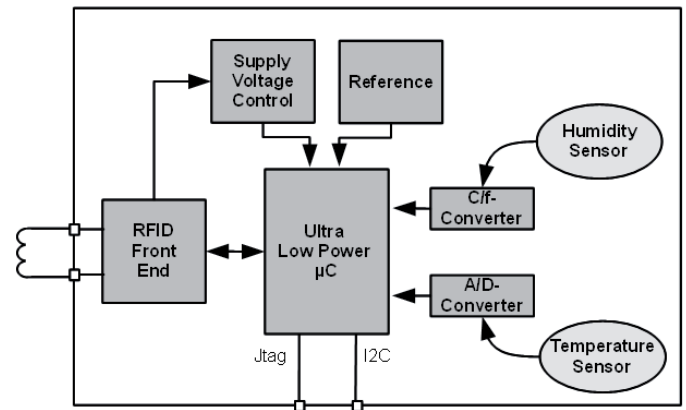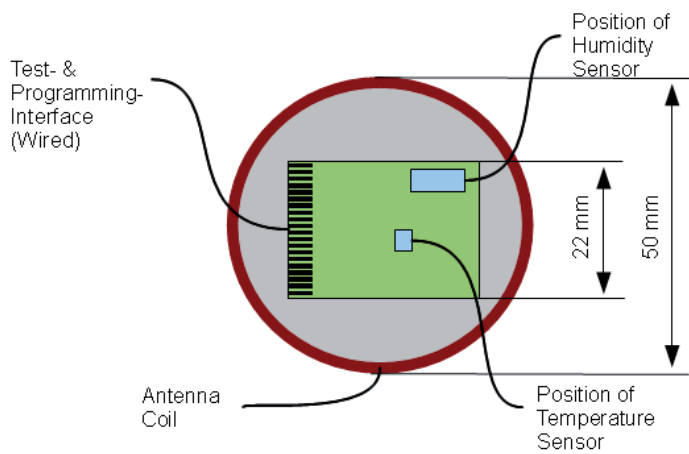
The related conversion circuit is optimised to be insensible against changing operating voltage caused by changing distance to the reader. An I²C interface allows the connection of external sensors and a JTAG interface is intended for user software upload to the flash memory of the microcontroller. The antenna resonant circuit has to be tuned to a frequency of 133.333 kHz. The equivalent impedance of the transponder is about 56 kΩ.

Layout and Dimensions

Figure 3 shows a simplified layout of the humidity transponder. The coil has a diameter of 50mm. The dimension of the PCB is 22mm x 28mm. The thickness amount is 2mm. Figure 4 shows the printed circuit board and the antenna coil.

RF Protocol

The humidity transponder uses a customized communication protocol. This protocol is optimised for passive sensor transponder operations. The physical layer is similar to ISO 18000. The transmitted data is Manchester coded. The data rate is 4 kBit/s. If the humidity transponder is in proximity of a reader, a continuous modulation is generated. If a measurement is completed, a respective data frame is sent. A frame consists of several segments:
- Header
- Tag
- Sensor Data
- CRC

The »tag« value indicates the kind of data that follows. This can be a humidity or tem-perature value or so called »CIDO« (calibration, ID, options) data. After powering up the humidity transponder the »CIDO« bytes are transmitted first. These bytes include the ID number and the calibration data for the humidity sensor. The temperature sensor does not need calibration data. After that further measurements are cyclically performed.

RF Parameters

Reader Unit Requirements
- Carrier frequency: 133.333 kHz ±1 kHz
- Field strength at transponder's position: 2.6 A/m

Transponder
- Modulation factor: typical 90%

Sensor Parameters

Humidity Sensing
- Humidity measurement range: 0 ... 100% (-20°C ... +85°C)
- Hysteresis: max. 1.5%
- Accuracy: typ. 5%

Temperature Sensing
- Temperature measurement range: -40°C ... +125°C
  ± 0.5°C (0°C ... +65°C)
  ±1.0°C (-20°C ... +85°C)

Wired Interface Pin Description

	Name	Description
1	Modulate	Data out
2	Gnd	Ground
3	-	n.c.
4	VCC	Supply voltage 3V
5	-	n.c.
6	-	n.c.
7	-	n.c.
8	Gnd	Ground
9	Gnd	Ground
10	-	n.c.
11	OutH	Testoutput Sensor
12	-	n.c.
13	TRS	JTAG-Interface
14	TMS	JTAG-Interface
15	TDI	JTAG-Interface
16	TCK	JTAG-Interface

Absolute Maximum Ratings

- Operating temperature: 20°C ... +85°C
- Storage temperature: 20°C ... +85°C
- Supply voltage VCC: +12V (in wired operation mode)

3 *Simplified layout of the humidity transponder*

4 *Block diagram of the transponder*