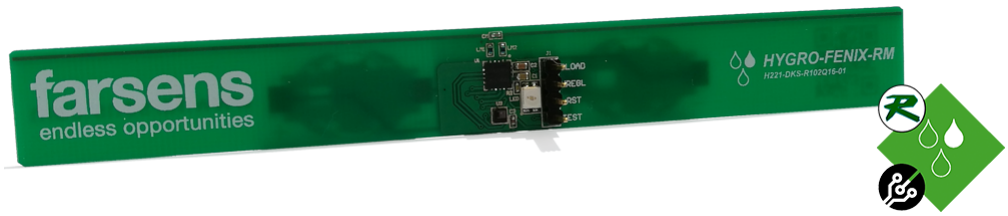
EPC C1G2 BATTERYLESS AMBIENT TEMPERATURE AND RELATIVE HUMIDITY SENSOR

Check for samples: EVAL01-HYGRO-FENIX-RM



FEATURES

- **EPC C1G2 compliant**
- **ISO 18000-6 Type C compliant**
- **160-bit EPC Bank: Up to 128-bit EPC**
- **96-bit TID Bank: Up to 48-bit Serial Number**
- **Available User Memory: Up to 1008-bit Non Volatile User Data**
- **Long range in passive mode: 5m**
- **Extended range in battery assisted passive mode: 20m**
- **Ambient Temperature sensor**
  - **Range: -40°C to 85°C**
  - **Accuracy: ± 1°C**
- **Relative Humidity sensor**
  - **Range: 0% rH to 100% rH**
  - **Accuracy: ± 3.5% rH**
- **Pick to light indicator for visual identification**

DESCRIPTION

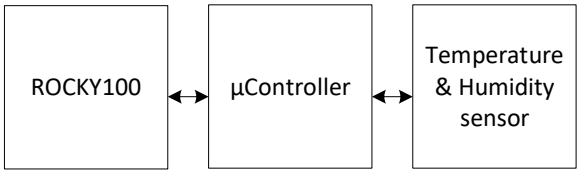
HYGRO-FENIX-RM is an EPC Class-1 Generation-2 (C1G2) RFID tag based on Farsens' batteryless sensor technology. Built in a compact PCB format, the tag includes an ambient temperature and relative humidity sensor.

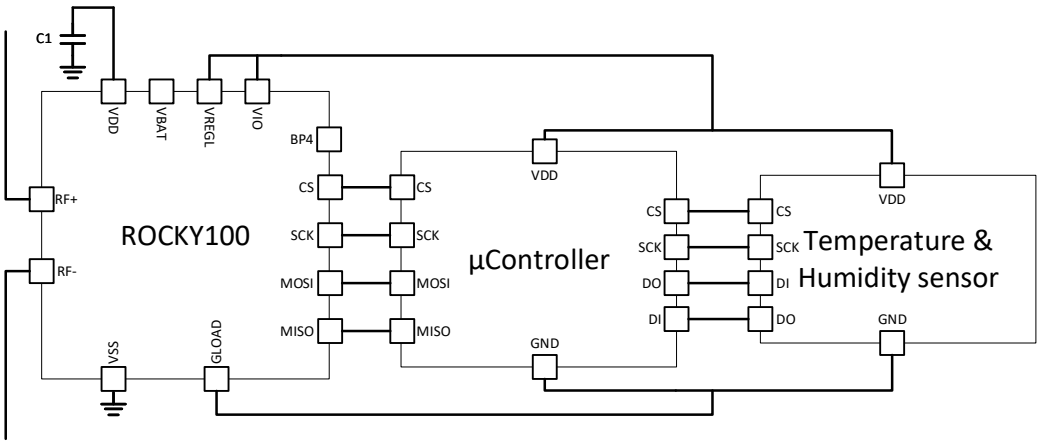
These RFID sensor tags are compatible with commercial UHF RFID readers (EPC C1G2). With a 2W ERP setup the battery-less resistance meter can communicate to over 5 meters - 16 feet.

The HYGRO-FENIX-RM can be customized with different antenna design and sizes, depending on the specific application. It can be encapsulated in an IP67 or IP68 casing for usage in harsh environments. It may also be possible to customize the specifications of the sensor upon request.

BLOCK DIAGRAM

The HYGRO-FENIX-RM tag consists of a ROCKY100 IC for energy harvesting and wireless communication, a microcontroler and a digital temperature and humidity sensor.





The ROCKY100 IC includes the RF frontend for UHF RFID power harvesting and communication, a power supply module to generate the required voltage levels, and an EPC C1G2/ISO18000-6C digital processor including a SPI bridge. The SPI bridge can be controlled via EPC C1G2 standard memory access commands.

The operation of measuring ambient temperature and relative humidity is controlled with a microcontroller. Besides the CPU and the memory, the microcontroller includes two SPI interfaces.

Finally, a digital temperature and humidity sensor provides the actual measurements.

The microcontroller is configured in such way that it updates the measurement of the temperature and humidity periodically. The capacitor C1 is included in the device in order to support the current peaks during measurements. Upon receiving a SPI directed read request from the UHF RFID reader, the ROCKY100 SPI bridge requests the value of the last measurement to the microcontroller, and includes it in the answer towards the reader.

CHARACTERISTICS

SYMBOL	PARAMETER	MIN	TYP	MAX	UNIT
RFID					
$r_{operation}$	Operation range full passive		5		m
	Operation range BAP		15		m
	Operation range EBAP		20		m
OPERATING CONDITIONS					
T_{OP_TOP}	Operating temperature range	-40		85	°C
TEMPERATURE SENSOR					
T_{range}	Temperature range	-40		85	°C
T_{acc}	Temperature accuracy				
	15°C to 40°C		±0.5		°C
	0°C to 60°C		±1		°C
T_{res}	Temperature resolution		1/64		°C
RELATIVE HUMIDITY SENSOR					
H_{range}	Humidity range	0		100	% rH
H_{acc}	Humidity accuracy				
	20% rH to 80% rH		±3.5		% rH
	0% rH to 100% rH		±5		% rH
H_{res}	Humidity resolution		1/256		% rH
H_{rms}	Humidity noise		0.03		% rH

OPERATION

EPC READING

In order to read the EPC of the tag, commercial EPC C1G2 readers can be used. However, some considerations have to be taken into account.

As the tag has a significant supply capacitor connected to VDD, the power-up of the system will be slow. It can last several seconds. In order to speed up the charge process, the reader shall be configured to send power as continuously as possible.

Once the supply capacitor is charged, the tag will respond with its EPC. From this point on, memory access commands can be used to control additional functionalities via the SPI bridge.

TEMPERATURE AND HUMIDITY READING

The temperature and humidity of the device can be read using standard EPC read commands. The answer to such command will include the value of the latter measurement of the device.

Read Temperature and Humidity

Operation: Read
Memory bank: User Memory
Word Pointer: 0x100
Word Count: 6

The answer from the tag to such a request will contain 12 bytes of data. Assuming that the reader returns the received data in the buffer of bytes *rawdata*, the content of the answer is defined as follows:

rawdata	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11
content	HEADER	FW_VER	HUMIDITY				TEMPERATURE				0x00	QOS

- HEADER (uint8): datagram header ’0xAA’. The header will be set once the micro-controller has taken the first measurement. If header is not set, the following fields have to be discarded.
- FW_VER (uint8): firmware version included in the micro-controller.
- HUMIDITY (binary32): relative humidity value in single precision floating point format (Little Endian). Value is given in *% rH*.
- TEMPERATURE (binary32): temperature value in single precision floating point format (Little Endian). Value is given in $^{\circ}C$.
- QOS (uint8): Quality Of Service provided by ROCKY100. Refer DS-ROCKY100 for further details on this parameter.

QOS	Meaning
0xFF	Sensor working in best conditions
0xEE	Sensor working in good conditions
0xCC	Sensor switched off
0x88	Sensor switched off

EXAMPLE OPERATION LOG

```
[10/07/2017 14:32:08] Start inventory... OK
[10/07/2017 14:32:09] Stop continuous inventory... OK
[10/07/2017 14:32:09] Read comamnd. Bank = User WordPtr = 0x00000100 WordCount = 4
                        Data Read = 0x000000000000000CC
[10/07/2017 14:32:09] QoS byte : 0xCC, Interpretation: VtagAboveVtagon
[10/07/2017 14:32:09] Invalid data header (received 0x00, expected 0xAA).
                        Discard received data
[10/07/2017 14:32:09] Start inventory... OK
[10/07/2017 14:32:10] Stop continuous inventory... OK
[10/07/2017 14:32:10] Read comamnd. Bank = User WordPtr = 0x00000100 WordCount = 4
                        Data Read = 0xAA013D0A52423333D14100FF
[10/07/2017 14:32:10] QoS byte : 0xFF, Interpretation: VloadAboveVloadon
[10/07/2017 14:32:10] Valid data header (0xAA). Process received data
[10/07/2017 14:32:10] Firmware revision = 0x01
[10/07/2017 14:32:10] Extract humidity value. Binary representation : 0x3D0A5242
                        Interpreted value (float/single) : 52,51
[10/07/2017 14:32:10] Extract temperature value. Binary representation : 0x3333D141
                        Interpreted value (float/single) : 26,15
```

In this example operation, continuous inventory is triggered by default to send power over the air. Every second, the continuous inventory is stopped, a temperature and humidity read command is sent and the response is interpreted. When done, the conitnuous inventory is triggered again to keep on sending power over the air so that HYGRO-FENIX-RM is energized.

In this example, the first resistance reading returns an invalid header, which means that the measurment buffer is still empty. The second measurement returns a valid header, and the following fields are interpreted in order to get the measured temperature and humidity values.

PICK TO LIGHT INDICATOR

The pick to light indicator of HYGRO-FENIX-RM can be triggered using standard EPC read commands. The PWM module of the ROCKY100 is used to control an LED. Upon receiving a not-null value write command directed to the PWM trigger register, HYGRO-FENIX-RM will generate the PWM signalling which will make the LED of the device blink according to the active configuration. By default, the device will generate 3 short blinks.

Trigger blink

Operation: Write
Memory bank: User Memory
Word Pointer: 0x91
Data: 0x01

DEMO SOFTWARE

Demonstration software to read and control the HYGRO-FENIX-RM is available in the web. Download the latest software and user guide at: http://www.farsens.com/software.php. Check the website for updated reader compatibility list. Up to the date of writing this document, this is the status of the compatibility list:

Fixed readers			
Manufacturer	**Model**	**Tested HW rev.**	**Tested FW rev.**
Impinj	R420	HLA: 1.00 | PCBA: 4.00	5.12.1
Impinj	R220	-	-
Impinj	R120	-	-
Nordic ID	Sampo	PWM00282	5.4 A
Nordic ID	Stix	PWM00226	5.10 A

REFERENCES

The next table shows the available references of the HYGRO-FENIX-RM.

Ref.	Name	Description
40502	EVAL01-HYGRO-FENIX-RM-DKWB	HYGRO-FENIX-RM, dipole wideband antenna, PCB format

For custom references with other antennas and housings, please contact us at sales@farsens.com.

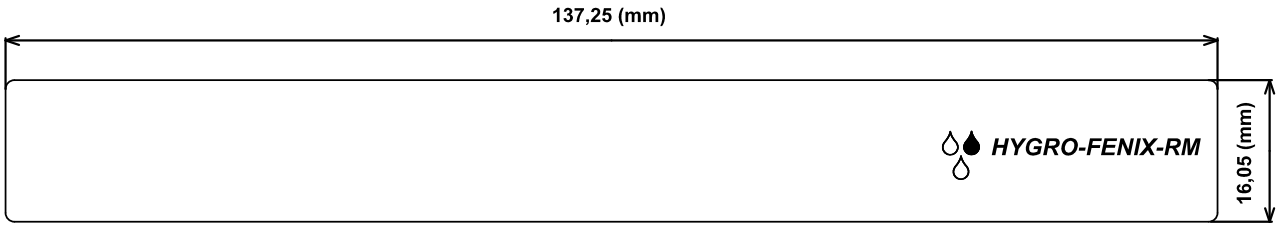
MECHANICAL DIMENSIONS

All dimensions are in millimeters.

DKWB

Valid for reference(s): 40502

2D VIEW



Maximum height: 10mm

3D VIEW