

EPC C1G2 BATTERYLESS PRESSURE SENSOR

Check for samples: [EVAL01-CYCLON-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
- Absolute pressure sensor
 - Pressure range: 0 bar to 14 bar
 - Pressure accuracy: ± 140 mbar
- Ambient temperature sensor
 - Temperature range: -40°C to 85°C
 - Temperature accuracy: $\pm 1^{\circ}\text{C}$
- Contact temperature sensor
 - Temperature range: -40°C to 85°C
 - Temperature accuracy: $\pm 1^{\circ}\text{C}$
- Pick to light indicator for visual identification

DESCRIPTION

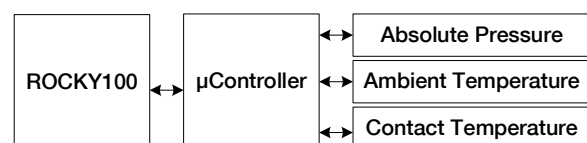
CYCLON-RM is an EPC Class-1 Generation-2 (C1G2) RFID tag based on Farsens' batteryless sensor technology. Built in a compact PCB format, the tag includes an absolute pressure sensor, an ambient temperature sensor and a contact temperature sensor.

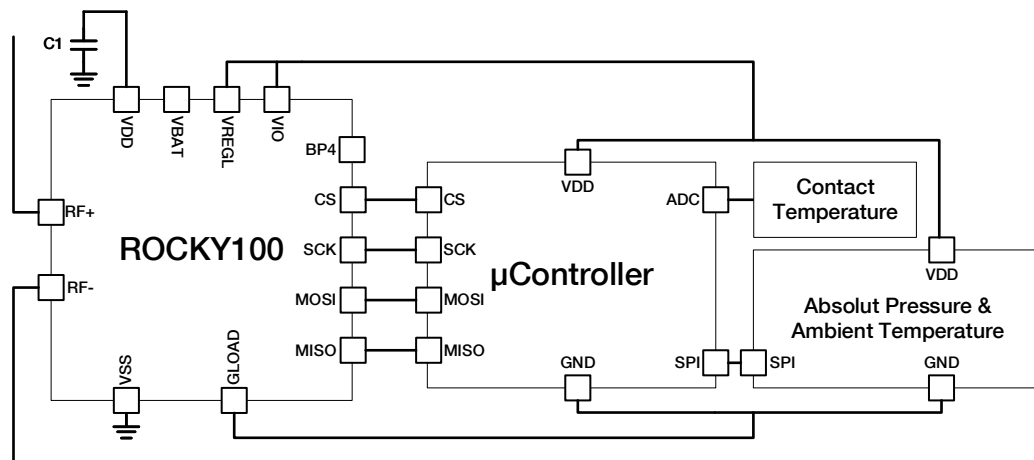
These RFID sensor tags are compatible with commercial UHF RFID readers (EPC C1G2). With a 2W ERP setup the battery-less light sensor can communicate to over 5 meters - 16 feet.

The CYCLON-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 CYCLON-RM tag consists of a ROCKY100 IC for energy harvesting and wireless communication, a microcontroller, an absolute pressure sensor, an ambient temperature sensor and a contact temperature 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 pressure and temperatures is controlled with a microcontroller. Besides the CPU and the memory, the microcontroller includes a SPI module and an ADC.

A digital pressure sensor provides the actual absolute pressure and ambient temperature measurement. Additionally, a NTC thermistor is connected to the ADC in order to get contact temperature.

The microcontroller is configured in such way that it updates the measurement of the sensors 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
ABSOLUTE PRESSURE					
P_{range}	Pressure range	0		14	bar
P_{acc}	Pressure accuracy		±140		mbar
P_{res}	Pressure resolution		14		mbar
AMBIENT TEMPERATURE					
T_{range}	Temperature range	-40		85	°C
T_{acc}	Temperature accuracy		±1		°C
T_{res}	Temperature resolution		0.1		°C
CONTACT TEMPERATURE					
T_{range}	Temperature range	-40		85	°C
T_{acc}	Temperature accuracy		±1		°C

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.

SENSORS READING

The pressure, the ambient temperature on the device and the contact temperature can be read using standard EPC read commands. The answer to such command will include the values of the latter measurements of the device.

Read Sensors Operation: Read
 Memory bank: User Memory
 Word Pointer: 0x100
 Word Count: 5

The answer from the tag to such a request will contain 16 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
content	HEADER	FW_VER	AMBIENT TEMPERATURE	NTC CONTACT RESISTANCE	PRESSURE		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.
- **AMBIENT TEMPERATURE** (int16): ambient temperature value in short integer (Little Endian). Value is given in °C multiplied by 100.
- **NTC CONTACT RESITANCE** (int16): ntc contact temperature resistance in short integer (Little Endian).

To convert the temperature resistance into kelvins, use the β parameter equation for $\beta = 3428K$ and $R_0 = 10,000$

$$r_{\infty} = 10000 * e^{-3428/298.15} \quad T = \frac{3428}{\ln(R_{ntc}/r_{\infty})}$$

- **PRESSURE** (int16): absolute pressure value in short integer (Little Endian). Value is given in *mbars*.

- 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

```
[13/02/2018 9:28:33] Start dummy continuous inventory to generate RF power ...OK
[13/02/2018 9:28:37] Stop dummy inventory to quit emitting RF power... OK
[13/02/2018 9:28:37] New read request received. Memory bank = User,
                        WordPtr = 0x00000100, WordCount = 5
[13/02/2018 9:28:37] Read command successfully completed.
                        Data read = 0x00010109542BE0038EFF
[13/02/2018 9:28:37] Start dummy continuous inventory to generate RF power ...OK
[13/02/2018 9:28:37] Invalid data header (received 0x00, expected 0xAA).
                        Discard received data
[13/02/2018 9:28:38] Stop dummy inventory to quit emitting RF power... OK
[13/02/2018 9:28:38] New read request received. Memory bank = User,
                        WordPtr = 0x00000100, WordCount = 5
[13/02/2018 9:28:39] Read command successfully completed.
                        Data read = 0xAA010809292BDF038EFF
[13/02/2018 9:28:39] Start dummy continuous inventory to generate RF power ...OK
[13/02/2018 9:28:39] Valid data header (0xAA). Process received data
[13/02/2018 9:28:39] Firmware revision = 0x01
[13/02/2018 9:28:39] Extract Contact Temperature. Binary representation : 0x6128,
                        interpreted value (double) : 24,1429730235733
[13/02/2018 9:28:39] Extract Air Temperature value. Binary representation : 0xB709,
                        interpreted value (float/single) : 24,87
[13/02/2018 9:28:39] Extract Pressure [mbar/hP]. Binary representation : 0xE703,
                        interpreted value (Int16) : 999
[13/02/2018 9:28:39] QoS byte : 0xFF, Interpretation :
                        [Before SPI transaction] VddAboveVloadOn (TRIM_VLON),
                        [After SPI transaction] VddAboveVloadOn (TRIM_VLON)
```

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

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

PICK TO LIGHT INDICATOR

The pick to light indicator of CYCLON-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, CYCLON-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 CYCLON-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
Alien	ALR9900	-	14.07.01.00
ThingMagic	Mercury6	1.0	4.19.3.2
Zebra	FX9500	-	1.5.4.348

Handheld readers				
Manufacturer	Model	OS	Tested HW rev.	Tested FW rev.
Nordic ID	Merlin	Windows CE 6.0	PWM00193	3.7.0
Zebra	MC9090G	Windows CE	x.xx	x.xx

REFERENCES

The next table shows the available references of the CYCLON-RM.

Ref.	Name	Description
41502	EVAL01-CYCLON-RM-DKWB	CYCLON-RM, dipole wideband antenna, PCB format

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

All dimensions are in millimeters.

Valid for reference(s): 41502

Technical drawing of the CYCLON-RM cyclone separator. The drawing shows a rectangular unit with a total width of 137,20 mm and a total height of 17,65 mm. The internal width is 128,00 mm. On the left side, there is a circular inlet with a diameter of 3,00 mm. On the right side, there is a circular outlet. The unit is labeled 'CYCLON-RM' with a starburst symbol next to it.

Maximum height: 10mm