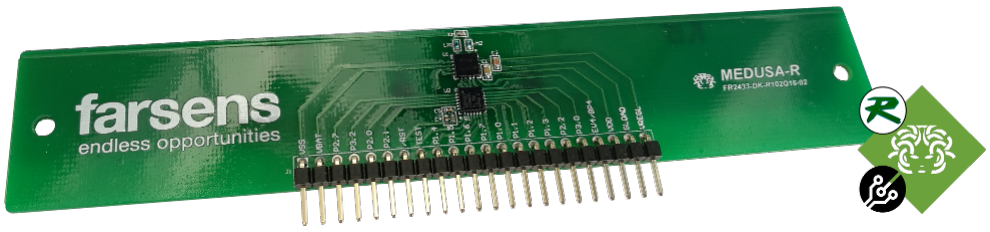
ROCKY100 POWERED EPC C1G2 BATTERYLESS SENSOR DEVELOPMENT PLATFORM FEATURING TI MSP430FR2433 MCU

Check for samples: EVAL01-MEDUSA-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**
- **Example FW and SW for ADC reading**

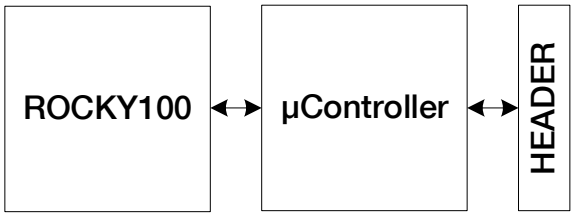
DESCRIPTION

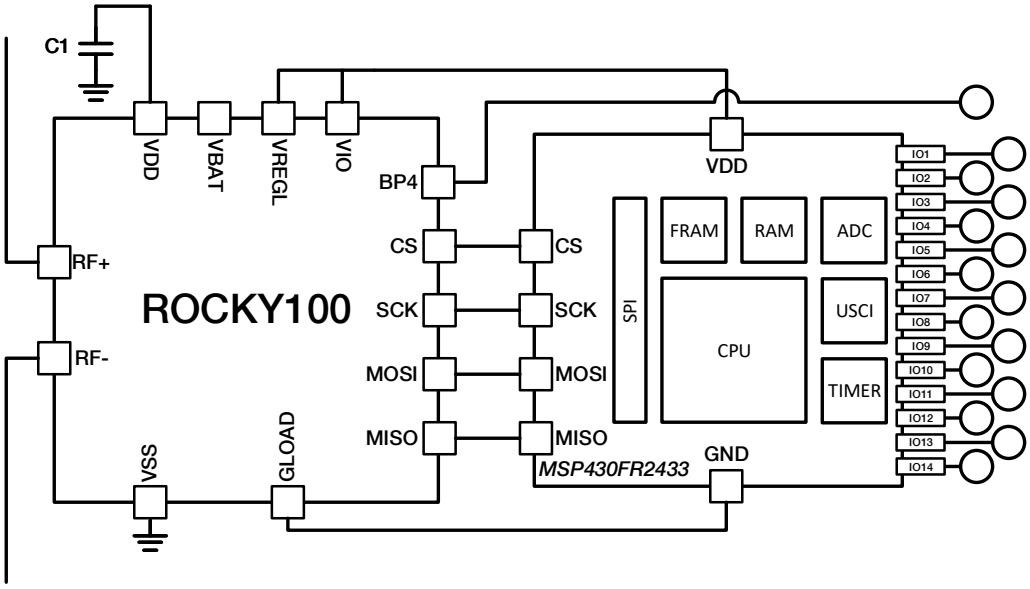
MEDUSA-RM is an EPC Class-1 Generation-2 (C1G2) RFID tag based on Farsens' batteryless sensor technology. Built in a compact PCB format, the tag includes a microcontroller. This tag is intended for developers willing to build proprietary batteryless sensor tags.

These RFID sensor tags are compatible with commercial UHF RFID readers (EPC C1G2). With a 2W ERP setup the battery-less development platform can communicate to over 5 meters - 16 feet. The actual communication distance can be reduced if additional power consumption is added to the tag.

BLOCK DIAGRAM

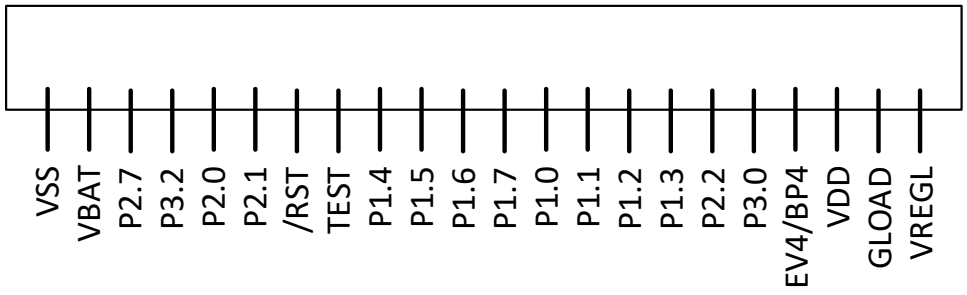
The MEDUSA-RM tag consists of a ROCKY100 IC for energy harvesting and wireless communication and a microcontroler with integrated ADC (10 bits), timers and USCI modules. All unused pins of the microcontroller are accesible through a standard 2.54mm pitch header.





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 amongst others. The SPI bridge can be controlled via EPC C1G2 standard memory access commands.

The SPI interface is connected to one of the USCIs of the MSP430FR2433 MCU. This low power microcontroller allows the developer to test different implementations of batteryless sensors. In order to connect the sensor specific additional circuitry, all the signaling of the PSM and free GPIOs of the microcontroller are accesible through a header. Additionally, the capacitor C1 is included in the device in order to support current peaks during measurements.



The microcontroller is configured with an example firmware that updates an ADC measurement of P1.6 periodically. 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

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.

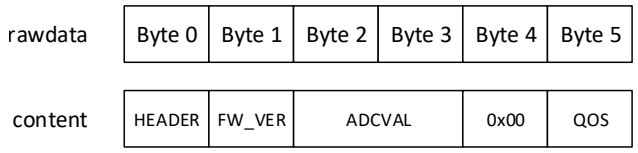
EXAMPLE ADC READING

With the example firmware, the ADC of the MCU in MEDUSA-RM 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 ADC

Operation: Read
Memory bank: User Memory
Word Pointer: 0x100
Word Count: 3

The answer from the tag to such a request will contain 6 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:



- 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.
- ADCVAL (int16): ADC value in signed integer format (Little Endian). Value is given in *LSB*.
- 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 = 0xAA02FD0300FF
[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 = 0x02
[10/07/2017 14:32:10] Extract ADC value. Binary representation : 0xFD03
                        Interpreted value (int16) : 1021
```

In this example operation, continuous inventory is triggered by default to send power over the air. Every second, the continuous inventory is stopped, an ADC 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 MEDUSA-RM is energized.

In this example, the first ADC 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 ADC value.

DEMO SOFTWARE

Demonstration software to read and control the MEDUSA-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 MEDUSA-RM.

Ref.	Name	Description
41202	EVAL01-MEDUSA-RM-DKWB	MEDUSA-RM, dipole wideband antenna, PCB format

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

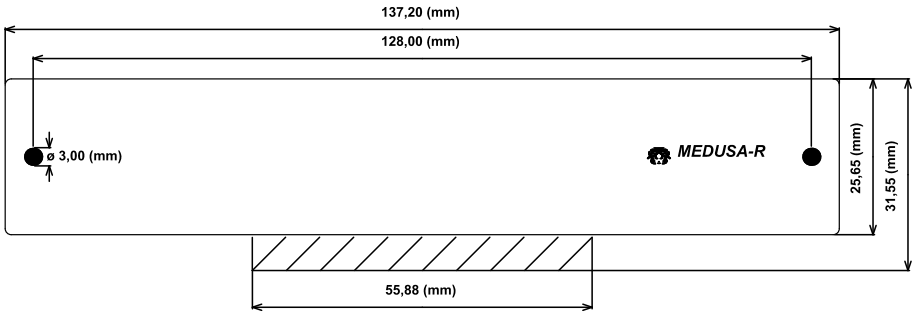
MECHANICAL DIMENSIONS

All dimensions are in millimeters.

DKWB

Valid for reference(s): 41202

2D VIEW



Maximum height: 10mm

3D VIEW