

EPC C1G2 BATTERYLESS ORIENTATION/TILT SENSOR

Check for samples: [EVAL01-KINEO-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
- 3-axis accelerometer (X,Y,Z)
 - Acceleration range: $\pm 4g$
 - Acceleration accuracy: ± 40 mg
 - Acceleration resolution: 2mg
- Pick to light indicator for visual identification

DESCRIPTION

KINEO-RM is an EPC Class-1 Generation-2 (C1G2) RFID tag based on Farsens' batteryless sensor

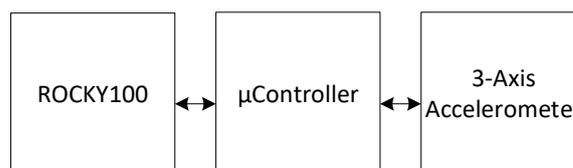
technology. Built in a compact PCB format, the tag includes an accelerometer.

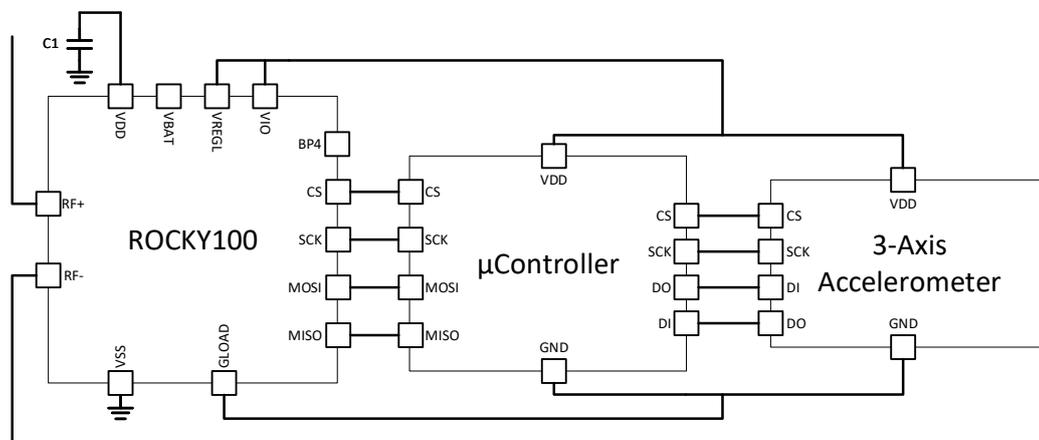
These RFID sensor tags are compatible with commercial UHF RFID readers (EPC C1G2). With a 2W ERP setup the battery-less orientation sensor can communicate to over 5 meters - 16 feet.

The KINEO-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 KINEO-RM tag consists of a ROCKY100 IC for energy harvesting and wireless communication, a microcontroller and a 3 axis accelerometer.





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 3-axis acceleration is controlled with a microcontroller. Besides the CPU and the memory, the microcontroller includes two SPI interfaces.

Finally, a digital 3-axis accelerometer provides the actual measurements.

The microcontroller is configured in such way that it updates the measurement of the 3-axis acceleration 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
ACCELEROMETER					
A_{range}	Acceleration range		±4		g
A_{acc}	Acceleration accuracy		±40		mg
A_{res}	Acceleration resolution ¹		2		mg

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.

ACCELERATION READING

The 3-axis acceleration of KINEO-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 Acceleration Operation: Read
 Memory bank: User Memory
 Word Pointer: 0x100
 Word Count: 5

The answer from the tag to such a request will contain 10 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	ACC_X	ACC_Y	ACC_Z	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.
- **ACC_X** (int16): acceleration value of X axis in signed integer format (Little Endian). Value is given in *mg*.
- **ACC_Y** (int16): acceleration value of Y axis in signed integer format (Little Endian). Value is given in *mg*.
- **ACC_Z** (int16): acceleration value of Z axis in signed integer format (Little Endian). Value is given in *mg*.
- **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 = 0x00000000000000CC
[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 = 0xAA010300E6FFEA0300FF
[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 X value. Binary representation : 0x0300
                        Interpreted value (int16) : 3
[10/07/2017 14:32:10] Extract Y value. Binary representation : 0xE6FF
                        Interpreted value (int16) : -16
[10/07/2017 14:32:10] Extract Z value. Binary representation : 0xEA03
                        Interpreted value (int16) : 1002
```

First, continuous inventory is triggered by default to send power over the air. Every second, the continuous inventory is stopped, a acceleration 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 KINEO-RM is energized.

In this example, the first acceleration 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 acceleration value.

PICK TO LIGHT INDICATOR

The pick to light indicator of KINEO-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, KINEO-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 KINEO-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 KINEO-RM.

Ref.	Name	Description
40602	EVAL01-KINEO-RM-DKWB	KINEO-RM, dipole wideband antenna, PCB format

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

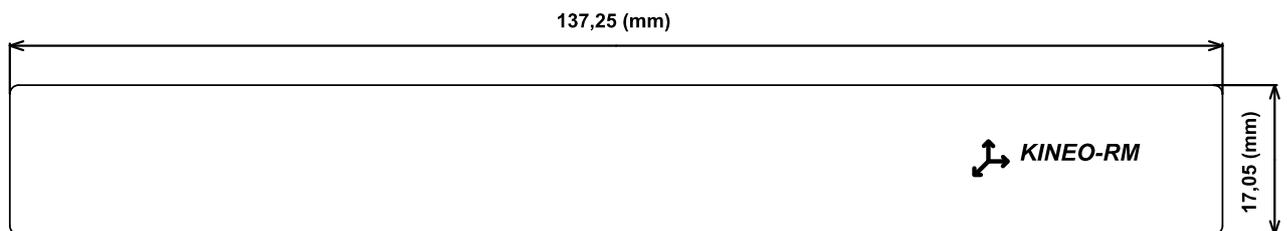
MECHANICAL DIMENSIONS

All dimensions are in millimeters.

DKWB

Valid for reference(s): 40602

2D VIEW



Maximum height: 10mm

3D VIEW

