**EPC C1G2 COMPLIANT BATTERYLESS TEMPERATURE AND PRESSURE SENSOR**

Check for samples: FENIX-VORTEX-P25H

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**DESCRIPTION**

FENIX-VORTEX-P25H 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 LPS25H temperature and pressure sensor from ST Microelectronics with a temperature range from -30°C to +85°C and a pressure range from 260 mbar to 1260 mbar.

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

The FENIX-VORTEX-P25H is available in a variety of antenna design and sizes, depending on the specific application. It can be encapsulated in an IP67 or IP68 casing for usage in harsh environments.

**FEATURES**

- 860MHz-960MHz operation
- EPC Class-1 Generation-2 compliant
- ISO 18000-6 Type C compliant
- 96-bit EPC & 32-bit TID
- Pressure range: 260 to 1260 mbar
- Pressure accuracy: ±0.1 mbar
- Pressure resolution: 0.020 mbar RMS
- Temperature range: -30°C to +85°C
- Temperature accuracy: ±2°C
- Temperature resolution: 0.025°C RMS

**BLOCK DIAGRAM**

The FENIX-VORTEX-P25H tag consists of an ANDY100 IC for energy harvesting and wireless communication, a start-up circuitry based on a voltage monitor and a LPS25H temperature and pressure sensor.
The ANDY100 IC includes a RF frontend for UHF RFID power harvesting and communication, a power supply module to generate the required voltage levels, a EPC C1G2/ISO18000-6C digital processor including a trimmed clock oscillator, a non volatile memory and a SPI master module. The SPI master module can be controlled via EPC C1G2 standard memory access commands.

In order to isolate the supply of the RFID tag from the supply of the rest of the system, the diode D1 is included. The capacitor C1 acts as an energy storage unit to support current peaks of the system during active operation, such as initialization and measurement.

A voltage monitor is included to connect the sensor system only after the energy storage capacitor has been charged. The voltage monitor connects the sensor system when the voltage in the capacitor is over 2.4V and disconnects the sensor system when the voltage falls below 1.8V. This architecture avoids oscillation of the system during initialization.

The sensor included in this tag is the LPS25H, which contains all the subsystems required to capture pressure and temperature data. The pressure sensing element consists of a suspended membrane realized inside a single mono-silicon substrate. The output of the pressure and temperature sensors is multiplexed to the low noise analog front end, and the data is digitized with the integrated ADC and digital filter. A digital signal processor is included to perform the temperature compensation on board. Finally, the data is made accessible through a SPI/I2C compatible interface.

In order to initialize the sensor, the RFID reader has to execute several write commands directed to the SPI memory space. Once the sensor has been configured in the desired operation mode, pressure and temperature data can be extracted executing read commands oriented to the proper addresses of the SPI memory space.
## CHARACTERISTICS

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>PARAMETER</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFID</td>
<td>RF sensitivity fully passive</td>
<td>-4</td>
<td>-2</td>
<td>0</td>
<td>dBm</td>
</tr>
</tbody>
</table>

### OPERATING CONDITIONS

<table>
<thead>
<tr>
<th>TOP_TOP</th>
<th>Operating temperature range</th>
<th>0</th>
<th>80</th>
<th>85</th>
<th>°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOP_ACC</td>
<td>Full accuracy temperature range</td>
<td>-30</td>
<td>0</td>
<td>80</td>
<td>°C</td>
</tr>
</tbody>
</table>

### PRESSURE SENSOR

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Value 1</th>
<th>Value 2</th>
<th>Value 3</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>P_range</td>
<td>Pressure range</td>
<td>260</td>
<td>0</td>
<td>1260</td>
<td>mbar</td>
</tr>
<tr>
<td>P_accR</td>
<td>Relative accuracy over pressure</td>
<td>±0.1</td>
<td>±0.2</td>
<td></td>
<td>mbar</td>
</tr>
<tr>
<td>P_accT</td>
<td>Absolute accuracy over temperature</td>
<td>-3.2</td>
<td>±2</td>
<td>2.6</td>
<td>mbar</td>
</tr>
<tr>
<td>P_noise</td>
<td>Pressure noise RMS ^1</td>
<td>0.020</td>
<td></td>
<td></td>
<td>mbar</td>
</tr>
</tbody>
</table>

### TEMPERATURE SENSOR

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Value 1</th>
<th>Value 2</th>
<th>Value 3</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>T_range</td>
<td>Temperature range</td>
<td>-30</td>
<td>0</td>
<td>85</td>
<td>°C</td>
</tr>
<tr>
<td>T_acc</td>
<td>Temperature accuracy</td>
<td>±2</td>
<td></td>
<td></td>
<td>°C</td>
</tr>
<tr>
<td>T_noise</td>
<td>Temperature noise RMS ^1</td>
<td>0.025</td>
<td></td>
<td></td>
<td>°C</td>
</tr>
</tbody>
</table>

^1: Root Mean Square
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. Refer to the application note *External capacitor on VDD of ANDY100* for detailed instructions on how to set up the reader for best performance.

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.

LPS25H initialization

In order to switch the sensor on, it is necessary to write a valid power mode. Moreover, the averaging configuration used for the measurement can be configured. This configuration has to be done at least once after the tag has been switched on. If the supply voltage suffers a voltage drop, the sensor will be reset. Thus, it is recommended to reconfigure these registers periodically or when all zero values are returned.

**Write Averaging Mode**

- **Operation:** Write
- **Memory bank:** User Memory
- **Word Pointer:** 0x10
- **Value:** 0x00 (recommended, refer to datasheet of LPS25H for customization)

**Write Power Mode**

- **Operation:** Write
- **Memory bank:** User Memory
- **Word Pointer:** 0x20
- **Value:** 0x94 (recommended, refer to datasheet of LPS25H for customization)

Once the sensor is initialized, the temperature and pressure data can be obtained reading the corresponding registers.

Temperature reading

**Read Temperature**

- **Operation:** Read
- **Memory bank:** User Memory
- **Word Pointer:** 0x2B
- **Word Count:** 2

The answer from the tag to such a request will contain 4 bytes of data. The EPC word size is 16bits and the SPI word size is 8bits. The answer received from the SPI interface is right aligned in the EPC words. Assuming that the reader returns the received data in the buffer of bytes *rawdata*, the content of the answer is defined as follows:
Pressure reading

Read Pressure
Operation: Read
Memory bank: User Memory
Word Pointer: 0x28
Word Count: 3

The answer from the tag to such a request will contain 6 bytes of data. The EPC word size is 16 bits and the SPI word size is 8 bits. The answer received from the SPI interface is right aligned in the EPC words. Assuming that the reader returns the received data in the buffer of bytes rawdata, the content of the answer is defined as follows:

```
// Get temperature value from sensor
Int16 rawTemp = (short)(rawdata[3] << 8 | rawdata[1]);

// Operate actual temperature
Float temp = (float)(42.5 + rawTemp/480.0);
```

```
// Get pressure value from sensor
rawPres = rawPres >> 8;

// Operate actual pressure
Float pres = (float)(rawPres / 4096.0);
```
DEMO SOFTWARE

Demonstration software to read and control the FENIX-VORTEX-P25H is available in the web. Download the latest software and user guide at: http://www.farsens.com/software.php. Currently, the software is compatible with the following UHF RFID readers:

Fixed readers
- Alien ALR9900
- AMS Radon
- Caen Muon DevKit - RS232
- CSL CS203
- Impinj R420
- Thingmagic M6
- Thingmagic M6e DevKit6
- Motorola FX9500
- Motorola FX7400/FX7500
- Nordic ID Sampo
- Nordic ID Stix
- RF-Embedded PUR500U
- Sirit IN610

Handheld readers
- Nordic ID Merlin
- Nordic ID Morphic
- Motorola MC9090G
- Motorola MC9190Z
REFERENCES

The next table shows the available references of the FENIX-VOXREX-P25H.

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>35702</td>
<td>FENIX-VOXREX-P25H-MKSWB</td>
<td>FENIX-VOXREX-P25H, meander wideband antenna, PCB format</td>
</tr>
</tbody>
</table>

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

All dimensions are in millimeters.

MKS

Valid for reference(s): 35702

Maximum height: 3mm