PULSE SENS'O

USER GUIDE

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Embedded software is based on Nke Watteco proprietary drivers and applicative code and operates on the Contiki kernel from the SICS (Swedish Institute of Computer Science).

www.watteco.com

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DOCUMENT HISTORY

Date	Revision	Modification Description
June 2015	1.0	First revision
March 2016	1.1	Add consumption estimation
May 2016	1.4	Add a default configuration
June 2016	1.5	Add the LoRaWAN cluster in the list for V3.4
November 2016	1.6	Add the FCC Label
May 2017	1.7	Update the FCC ID

CONTENTS

1 INTRODUCTION

This document describes the usage of the Pulse Sens'o sensor. It is necessary to read the LoRaWAN Sensors Behavior on Public LoRaWAN Networks guide and the Application Layer Description guide in prerequisite for all generic information or to have more details.

1.1 GENERAL DESCRIPTION

The Pulse Sens'o uses a disposable A 3.6V battery as power supply. An estimated lifetime is given in one of the following chapter.

Connect wires on Inputs which will be used. For connector, it is preferable to use several single wires with a gauge of 20-26 AWG. As the connectors pluck the wires plugged to their bottom at about 4mm of the wire-end, strip the wires on about 5 to 6 mm of their extremity pluged into the connector.

For watter protection, it is recommended to use moulted cable.

The housing is intended to be installed inside or outside a building but to the shelter of a vertical splash water and direct sunlight.

The Pulse Sens'o sensor manages an internal power supply on the battery. Switch on the switch "Power Off" to start-up the device. The green "ASS" led has to be blinked until an association.
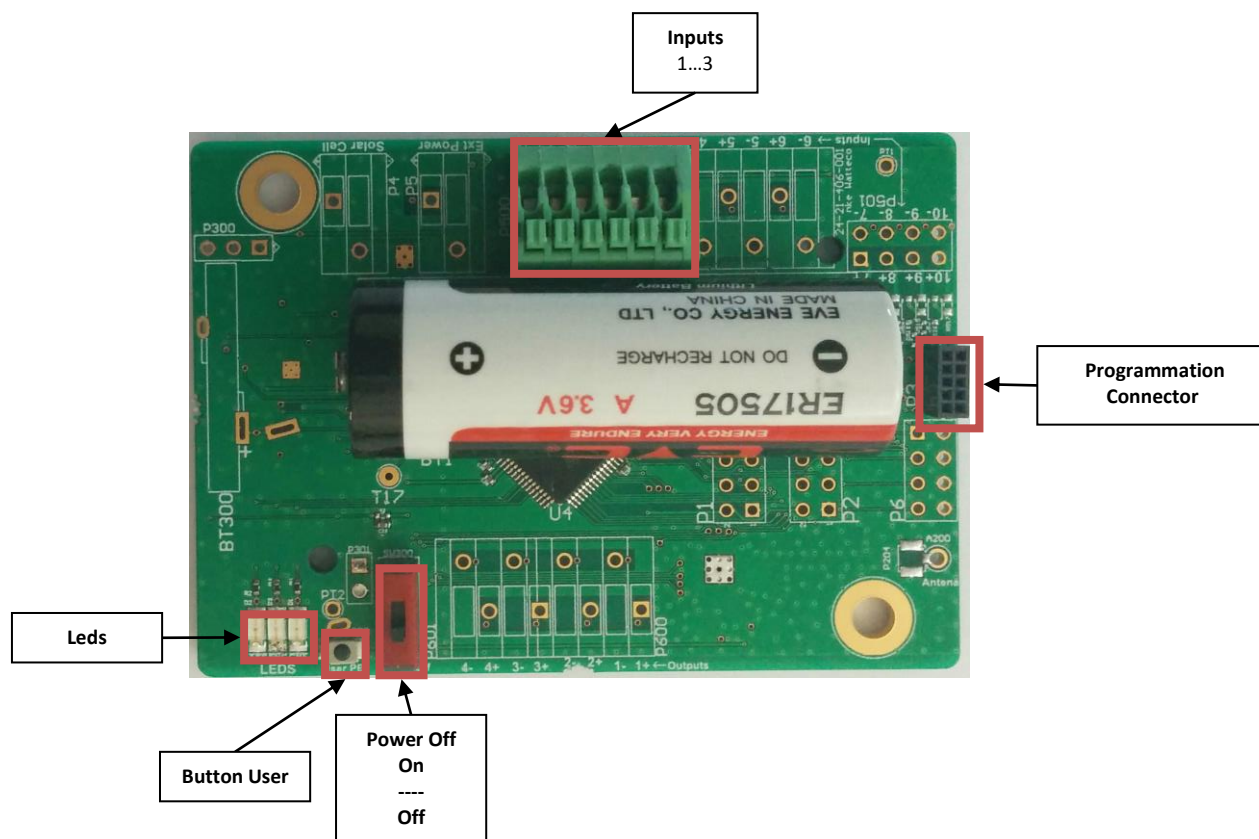
1.2   ELECTRONIC INPUT/OUTPUT

1.2.1   ELECTRICAL SCHEMATIC EXAMPLE FOR INPUTS
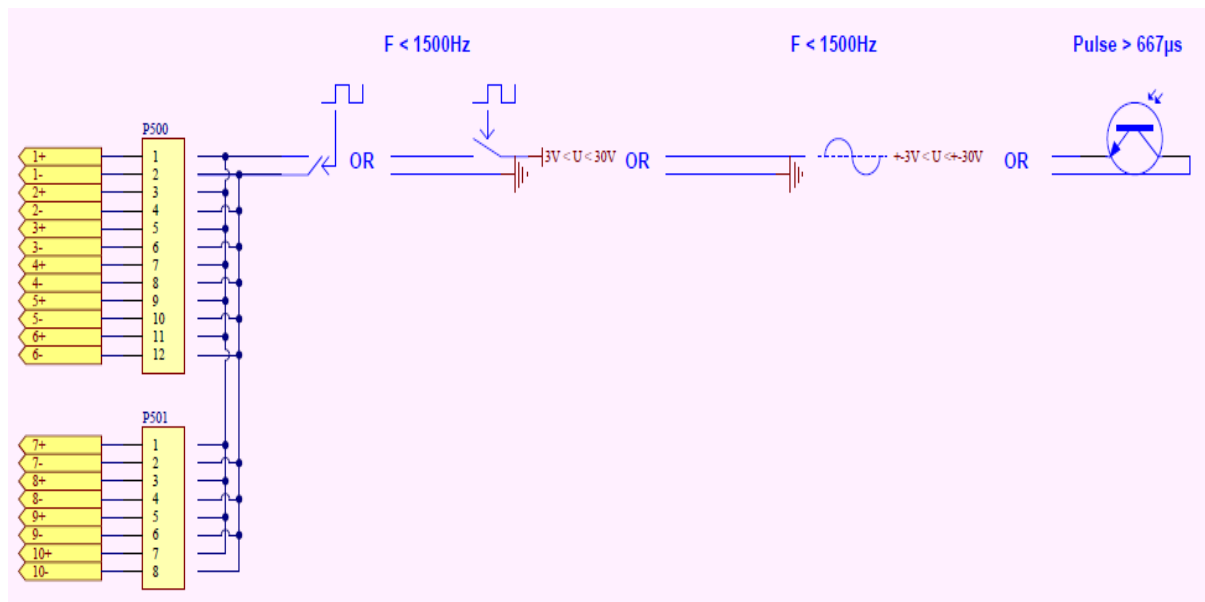
Due to limitation software, the maximum frequency is 100 Hz on each input.

1.3   HUMAN MACHINE INTERFACE

There is three leds on the ILD and IN'O devices:

- ASS: blinking until the association to a network is done.
- FNC: blinking each minute while an input is activated.
- CNF: blinking in the configuration mode.

A button user is available to enter in configuration mode.

1.4 APPLICATIVE LAYER

The Pulse Sens'o device is a sleepy device. It implements "Binary Input" clusters, associated to their Inputs. The corresponding between the connectors and the EndPoint is done below:

Connector	End Point	Cluster
Input 1+/1-	0	Binary Input
Input 2+/2-	1	Binary Input
Input 3+/3-	2	Binary Input

Pulse Sens'o integrates clusters:

Cluster	Cluster name	Managed attributes
0x0000	Basic	All
0x0050	Configuration	All
0x8004	LoRaWAN (for V3.4 version)	All
0x000F	Binary Input	All

1.4.1 DEFAULT CONFIGURATION

Since the v3.4 release, a default configuration is set:

- The device reports each day the counter associated to the input 1+/1- (EndPoint 0 / Cluster Binary Input /Attribut Count), the input 2+/2- (EndPoint 1 / Cluster Binary Input /Attribut Count), the input 3+/3- (EndPoint 2 / Cluster Binary Input /Attribut Count).

2 CONSUMPTION

2.1 EUROPE MODE

Lifetime Simulator

PHY Frame Size Tx	75	Bytes
PHY Frame Size Rx (ACK)	15	Bytes
Transmission period	Period	s
Duty cycle	0.10%	
Battery :		
Theoritical capacity	**3600**	mAh
Actual capacity	3060	mAh
Radio Consumption:		
Transmission	40	mA
Reception	10	mA
Measuring (Rx)		
Measuring Period	**60**	s
Measuring duration	0	s
Active measuring consumption	0	mA
Basic consumption (sleeping) :	0.004	mA

Duty cycle Respect

Period(s)/SF	7	8	9	10	11	12
60	No	No	No	No	No	No
120	Yes	No	No	No	No	No
600	Yes	Yes	Yes	No	No	No
3600	Yes	Yes	Yes	Yes	Yes	Yes
7200	Yes	Yes	Yes	Yes	Yes	Yes
14400	Yes	Yes	Yes	Yes	Yes	Yes
86400	Yes	Yes	Yes	Yes	Yes	Yes

Estimated Lifetime (in year)

Period(s)/SF	7	8	9	10	11	12
60	4.32	2.52	1.44	0.81	0.36	0.21
120	8.24	4.91	2.83	1.60	0.73	0.41
600	29.91	20.03	12.54	7.45	3.51	2.03
3600	66.16	55.98	43.79	31.35	17.55	10.92
7200	75.29	68.23	58.33	46.14	29.22	19.41
14400	80.86	76.60	69.94	60.38	43.79	31.76
86400	86.18	85.34	83.85	81.28	74.91	67.61

3 EXAMPLES

In the following examples, the 6lowpan header has been removed for an easier understanding. See 6LOWPAN LAYER OVER LORAWAN™ in the LoRaWAN Sensors Behavior on Public LoRaWAN Networks guide, for more details.

3.1 CONFIGURE A BATCH REPORT ON BINARY INPUT COUNTER, AND VOLTAGE BATTERY

Specification: *Timestamp and record the pulses counter with a resolution of 1, a value has to be saved at least all the 30 minutes or on a rise of 100 pulses.* Timestamp and r*ecord the battery voltage with a resolution of 0.1V, a value has to be saved at least all the 24 hours. All data have to be concatenated and sent at maximum all the 24 hours.*

Solution: The solution to concatenate several different physical values in the same frame is to use the batch reporting. For the batch it is necessary to know the number of physical measures that will be sent in order to choose a label for each of them and the size of these labels.

According to the previous paragraph, we will have only two kinds of measure to manage, thus two different labels.

Number of Label	Tag Label	Tag Size
1 or 2	0 / 1	1
3 or 4	00 / 01 / 11 / 10	2
5 or 6 or 7 or 8	000 / 001 / 010 / 011 / 100 / 101 / 110 / 111	3
…		

The tag Size to use for two labels is 1. Label 0 can be used for binary input Counter and label 1 for the level of disposable Battery.

To configure the batch, it is necessary to send a command of "Configure reporting" at each cluster.

For the binary input counter the delta has to be set to 100=0x00000064, minimum to 0=0x0000 (0 seconds), the maximum to 30=0x801e (30 minutes), the resolution to 1=0x00000001 (1) and the tag to 0b00000001=0x01 (size 1 and label 0). The cluster to report is 0x000F and the attribut 0x0402 (Count).

> *Request:*   *1106000f1d0402000000801e000000640000000101*
>
> *Response:*   *1107000f00010402*

For Disposable Battery power voltage the delta has to be set to 100=0x0064 (0.1V), minimum to 10=0x800a (10 minutes), the maximum to 24*60=1440=0x85A0 (24 hours), the resolution to 100=0x0064 (0.1V), the tag to 0b00001001=0x09 (size 1 and label 1), the field to 4=0x04. The cluster to report is 0x0050 and the attribut 0x0060 (Node power descriptor).

> *Request:*   *11060050015000604800a85a00064006409*
>
> *Response:*   *1107005000010006*

To decode the batch reception, use the br_uncompress. Type for binary input counter is U32 (10) and is U16 (6) for the disposable battery power. Thus, it is necessary to use this command:

```
echo "26150020e06001d71e0000a0650f" | ./br_uncompress -a  1 0,1,10 1,100,6
```

Result:

> *UNCOMPRESS SERIE*
> cnt: 5   # Counter of the batch (from 0 to 7)
> 263   # Timestamp in second of sending of the frame
>
> # Format of data is: TimeStamp of Measure | Label | Value
>
> 263 0 45   # TimeStamp: 841 s   Label 0: Counter pulse   Value: 45
>
> 263 1 3000   # TimeStamp: 811 s   Label 1: Disposable   Value: 3.0 V

⇨ With the batch only one frame of 14 applicatives bytes is sent, instead of 2 frames representing 24 applicatives bytes.   With the MAC and 6lowpan header, 21 bytes for the batch are sent against 38 bytes for a standard report. The gain is around 41% in this very simple case. It could be better as soon as there are more than one value by label in the batch.

3.2 CONFIGURE A STANDARD REPORT ON THE CONNECTOR INPUT 1+/1-

Specification: *Report immediately the counter all the 5 pulses on the connector Input 1+/1-. The counter has to be reported at least each hour.*

Solution: A counter on Input 1+/1 is the End Point 0, Cluster "Binary Input" is 0x000F, Attribut "Count" is 0x0402. The maximum field has to be 0x0e10 to have a report all one hour and the minimum field has to be 0x0000 to have a report immediately after the right incrementation. The right incrementation, i.e. the delta has to be configured to 0x05 for a report all the 5 pulses.

Applicative payload is: *1106000f0004022300000e1000000005*

3.3 CONFIGURE A STANDARD REPORT ON THE CONNECTOR INPUT 3+/3-

Specification: *Report the counter all the 1 pulse on the connector Input 3+/3-. The counter has to be reported at least each 10 minutes, and a minimal timing of 10 seconds between 2 reports has to be setted to optimize the consumption.*

Solution: A counter on Input 3+/3- is the End Point 2, Cluster "Binary Input" is 0x000F, Attribut "Count" is 0x0402. The maximum field has to be 0x800A to have a report all 10 minutes and the minimum field has to be 0x000A to have a minimal timing between two reports. The delta has to be configured to 0x01 for a report all the 1 pulses.

Applicative payload is: *5106000f00040223000a800a00000001*

3.4 CONFIGURE A BATCH REPORT ON THE CONNECTOR INPUT 2+/2- AND THE CONNECTOR INPUT 3+/3-

Specification: Timestamp and r*ecord the Input 2+/2- all the 100 pulses; and timestamp and record the level of the Input 3+/3-. A report has to be sent at least all 24 hours.*

Solution: A counter on Input 2+/2- is the End Point 1, Cluster "Binary Input" is 0x000F, Attribut "Count" is 0x0402. A level on Input 3+/3- is End Point 2, Cluster "Binary Input" is 0x000F, Attribut "Present Value" is 0x0055. There are two different values to record in the batch, so the tag size has to be 1. Label 0 can be used for counter, and Label 1 for level. For counter, the delta is 100 and resolution 1. For level, the delta is 1 and the resolution 1. The maximum has to be configured for all to 0x85A0.

It is necessary to send two frames to configure this batch.

Applicative payloads are:

3106000f1d040200000085A0000000640000000101   *(Count)*

5106000f11005500000085A0010109   *(Present Value)*

4 APPENDIX

4.1 PULSE SENS'O FCC LABEL

> **FCC ID: 2AGTVNKE170062**
>
> **PULSE SENS'O SENSOR**
>
> This device complies with Part 15 of the FCC Rules.
> Operation is subject to the following two conditions: (1) this
> device may not cause harmful interference and (2) this
> device must accept any interference received, including
> interference that may cause undesired operation.

⚠ *Caution:* **Changes or modifications not expressly approved by the party responsible for FCC compliance could void the user authority to operate the device. (Cf. FCC Part 15.21).**