S0 (OR PULSE SENSOR)

USER GUIDE

NOTICE

Nke Watteco reserves the right to make changes to specifications and product descriptions or to discontinue any product or service without notice. Except as provided in Nke Watteco's Standard Terms and Conditions of Sale for products, Nke Watteco makes no warranty, representation or guarantee regarding the suitability of its products for any particular application nor does Nke Watteco assume any liability arising out of the application or use of any product and specifically disclaims any and all liability, including consequential or incidental damages.

Certain applications using semiconductor products may involve potential risks of death, personal injury or severe property or environmental damage. Nke Watteco products are not designed, authorized or warranted to be suitable for use in life saving or life support devices or systems. Inclusion of Nke Watteco products in such applications is understood to be fully at the Customer's risk.

In order to minimize risks associated with the customer's application, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

Nke Watteco assumes no liability for applications assistance or customer product design. Nke Watteco does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of Nke Watteco covering or relating to any combination, machine or process in which such semiconductor products or services might be or are used. Nke Watteco's publication of information regarding any third party's products or services does not constitute Nke Watteco's approval, warranty and endorsement thereof.

Resale of Nke Watteco's products with statements of functionality different from or beyond the parameters stated by Nke Watteco for that product as defined by Nke Watteco's unique part number, voids all express and any implied warranties for that product, is considered by Nke Watteco to be an unfair and deceptive business practice and Nke Watteco is not responsible nor liable for any such use.

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).

http://www.nke-watteco.com/

DOCUMENT HISTORY

Date	Revision	Modification Description
September 2015	1.0	First revision
November 2015	1.1	Adding the US mode part in consumption and FCC label

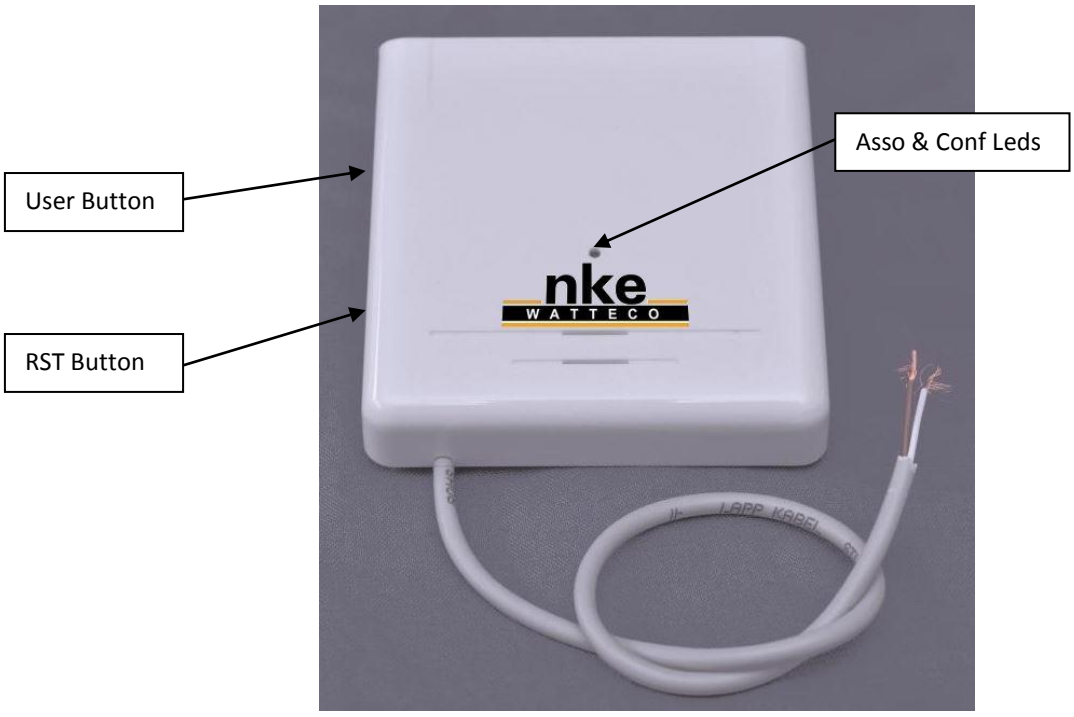
CONTENTS

1 INTRODUCTION

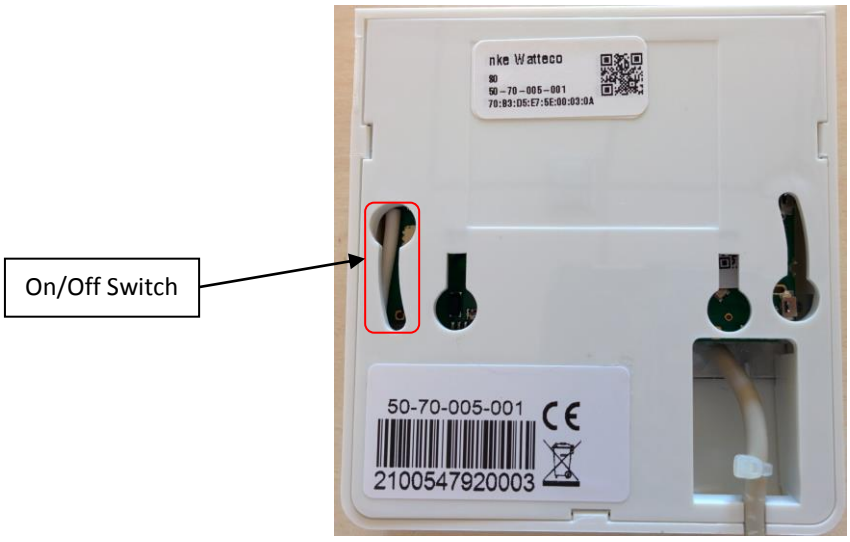
This document describes the usage of the S0 sensor. It is necessary to read the Application Layer Description guide and the LoRaWAN Sensors Behavior on Public LoRaWAN Networks guide in prerequisite for all generic information.

1.1 GENERAL DESCRIPTION

The S0 sensor use a ½ AA 3.6V battery as a power supply.
The pulse input is actually a cable with two separate wires: brown and white. The brown one has to be connected to the ground and the white to the pulse generator output.

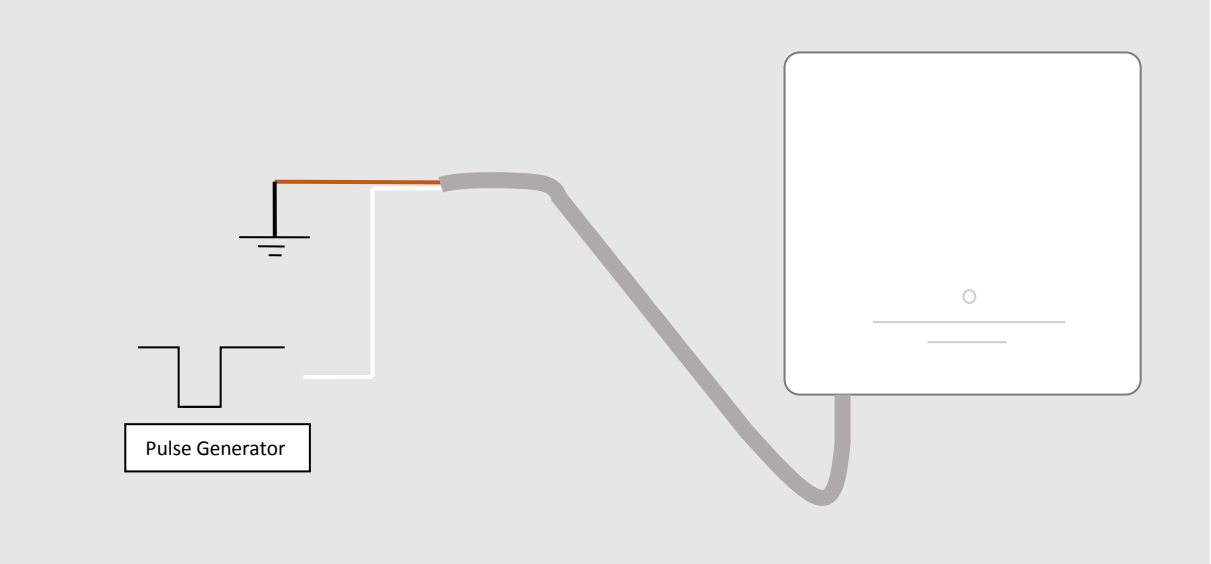


NOTES: ***This device can be switched ON and OFF*** *through a small switch accessible at the left side on the back. Set the switch up, to switch ON the device. This switch can be seen on the illustration here below.*



2 ELECTRONIC INPUT/OUTPUT

2.1 ELECTRICAL SCHEMATIC EXAMPLE FOR INPUT



3 HUMAN MACHINE INTERFACE

There is two leds on the THr device:

- Green: blinking until the association to a network is done.
- Red: blinking in the configuration mode.

A button user is available to enter in configuration mode by pushing once on it. The pushing during 10 seconds on the User button makes a reset factory.

4 APPLICATIVE LAYER

The S0 device is a sleepy Class A device. It integrates these following clusters:

Cluster	*Cluster name*	*Managed attributes*
0x0000	Basic	All
0x0050	Configuration	All
0x000F	Binary Input	All

5 CONSUMPTION

5.1 EUROPE MODE

Estimateur durée de vie capteur Pile

Taille trame PHY Tx	45	Octets
Taille trame PHY Rx (ACK)	15	Octets
Périodicité émission	Period	s
Duty cycle souhaité	0,10%	
Pile :		
Capacité théorique	**1200**	mAh
Capacité utile	1020	mAh
Consommation radio:		
En emission	40	mA
En réception	10	mA
Mesure (Rx)		
Période mesure	**60**	s
Durée mesure*	0	s
Conso mesure active**	0	mA
Conso base (endormi) :	0,004	mA

SF	Débit (bps)
7	5470
8	3125
9	1760
10	980
11	440
12	250

Consommation par report acquité

SF	7	8	9	10	11	12
dTx (s)	0,07	0,12	0,20	0,37	0,82	1,44
dRx (s)	0,02	0,04	0,07	0,12	0,27	0,48
Conso (uAh)	0,79	1,39	2,46	4,42	9,85	17,33

Respect Duty cycle

Period(s)/SF	7	8	9	10	11	12
60	Non	Non	Non	Non	Non	Non
120	Oui	Oui	Non	Non	Non	Non
600	Oui	Oui	Oui	Oui	Non	Non
3600	Oui	Oui	Oui	Oui	Oui	Oui
7200	Oui	Oui	Oui	Oui	Oui	Oui
14400	Oui	Oui	Oui	Oui	Oui	Oui
86400	Oui	Oui	Oui	Oui	Oui	Oui

Longévité estimée (En années)

Period(s)/SF	7	8	9	10	11	12
60	2,26	1,34	0,77	0,43	0,20	0,11
120	4,19	2,55	1,50	0,85	0,39	0,22
600	13,30	9,45	6,20	3,81	1,85	1,08
3600	24,30	21,62	18,02	13,83	8,41	5,46
7200	26,49	24,81	22,26	18,75	13,05	9,19
14400	27,74	26,79	25,23	22,81	18,02	13,97
86400	28,87	28,70	28,38	27,83	26,40	24,66

5.2 US MODE

Battery sensor: life time Estimator

PHY Frame Size Tx	45	Octets
PHY Frame Size Rx (ACK)	15	Octets
Transmission period	Period	s
Battery :		
Theoritical capacity	1200	mAh
Actual capacity	1020	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

Consumption per report acknowledged

					500 kHz
SF	**7**	**8**	**9**	**10**	**8**
dTx (s)	0,07	0,12	0,20	0,37	0,03
dRx (s)	0,01	0,01	0,02	0,03	0,01
Conso (uAh)	0,75	1,31	2,32	4,17	0,35

Estimate Lifetime (Years)

Period(s)/SF	**7**	**8**	**9**	**10**	**8**
60	2,39	1,41	0,81	0,46	4,70
120	4,41	2,70	1,58	0,90	8,09
600	13,73	9,83	6,50	4,01	19,15
3600	24,53	21,94	18,42	14,26	26,79
7200	26,63	25,02	22,56	19,14	27,90
14400	27,81	26,91	25,42	23,09	28,49
86400	28,88	28,72	28,42	27,90	29,00

SF (at 125 kHz)	BaudRate (bps)	Equivalent LoRaWAN DR
7	5470	**DR 3**
8	3125	**DR 2**
9	1760	**DR 1**
10	980	**DR 0**
11	440	**NA**
12	250	**NA**

SF (at 500 kHz)	BaudRate (bps)	Equivalent LoRaWAN DR
7	21900	**DR 13**
8	12500	**DR 12**
9	7000	**DR 11**
10	3900	**DR 10**
11	1760	**DR 9**
12	980	**DR 8**

6 EXAMPLES

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

6.1 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 *record the battery voltage with a resolution of 0.1V, a value has to be saved at least all the 24 hours. All datas 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 measure will be sent 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 2 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 30=0x001e (30 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: *1106000f1d040200001e801e000000640000000101*

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 0x0006 (Node power descriptor).

Request: *1106005015000604800a85a00064006409*

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, so 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 simple case.

6.2 CONFIGURE A STANDARD REPORT ON THE BINARY INPUT COUNTER

Specification: *Report immediately the value of the counter every 500 pulses. This measure has to be reported at least each hour.*

Solution: Cluster "Binary Input" is 0x000F, Attribut "Count" is 0x0402. The maximum field has to be 0x0e10 (3600 s) to have a report every hour and the minimum field has to be 0x0000 to have a report immediately after the right variation. The delta has to be configured to 500=0x000001f4.

Applicative payload is: *1106000f0004022300000e10000001f4*

7 APPENDIX

7.1 FCC LABEL

FCC ID: 2AGTV50-70-005

PULSE 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).**