Intens’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).

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

DOCUMENT HISTORY

Date	Revision	Modification Description
Novembre 2017	1.0	First revision
23/11/2017	1.1	Add reference to LoRaWAN_Sensors_Application_Layer_Addon_001_V1_0.pdf

CONTENTS

1 INTRODUCTION

This document describes the usage of the Intens'o sensor. It is necessary to read the website http://support.nke-watteco.com/ for all generic information about LoRaWAN or standard nke Watteco application Layer and more.

1.1 GENERAL DESCRIPTION

1.1.1 FUNCTIONAL DESCRIPTION

Inten'so permits the detection and of AC current intensity passing through a simple conductor. In its standard configuration the sensor is not aimed to give a precise measurement in it's full range. Its standard application filed is detection of correct behavior of industrial appliance like street lighting, escalator, elevator … Following array gives mains precision according to measured crrent:

Current range	Precision	Notes
0,0 - 0,5A	_*	In standard configuration measuring current less than 500 mA is not possible. Then 0 A is returned. In that case user should multply wire turns in curent transformer.
0,5 - 1 A	30 %	
1 - 3 A	10 %	
3 - 17 A	2%	
17 - 18 A	10 %	
18 - 20 A	20 %	
20 - 30 A	30 %	
30 - A	_*	

** Upon specific demands the current transformer and standard electronic input can be changed to cope with specific use cases*

Sensor casing is an IP55 box conforms to UL94-V2 inflammability norm.

Different functions are available in Intens'O:

Data logger: measures and records at a specific resolution the measured current on periodicity or/and on variation. Sends all recorded measures on periodicity in a "batch" report. *By default batch reporting is not set.*

Alarm: possibility to set alarm on thresholds or variation of current. The measure is done according to the default reporting configuration. The "standard" report is used for this feature. The **resolution** is **0.1 A**. *By default the alarm is set on threshold of crossing threshold rising and falling at 1 ± 0.5 Amps.*

1.1.2 MAIN CHARACTERISTICS

Out of factory the sensor works in EU bands (863 to 870 MHz), but it can be configured for other ISM frequency bands (US or others) upon customer demand.

For the EU case the default radio Tx power is 14 dBm.

Intens'O sensor is a Class A LoRaWAN sensor It is powered by a 3,6 Ah A battery that can only be replaced in factory.

The current transformer is delivered with a 3 meters cable allowing moving the sensor casing in the more efficient radio position around the measurement position.

1.2 INSTALLATION

1.2.1 CURRENT TRANFORMER SETUP

User must open current transformer to clip it around a single wire: Phase OR Neutral. Both wires MUST NOT be placed together in the current transformer.

Even if an arrow is present on the current transformer, no particular direction has to be respected.

Beware having firmly clipped the tore around the wire. A slight "clic" must be heard.

1.2.2 CASING FIXATION

From factory, the casing is equipped with a "scratch adhesive band" that make the sensor easily removable from its support. After sticking the adhesive part to the support, the sticker should not be removed during about 48h to have best resistance.

Alternatively the casing may be screwed to the support however this imply opening the casing and carefully carrefuly screw the casing without damaging the inside electronics parts.

Important: To get the best radio coverage the box should be fixed on the support such as stickers are normally/horizontally readable.

1.2.3 CURRENT TRANSFORMER CONNEXION

The current transformer cable is connected to the sensor through a black connector. It must be simply pushed toward after having set both white strips aligned. There is no need for rotation.

The installator should take care about fixing the wire of current transformer to avoid any ulterior grabbing.

1.2.4 DEVICE STARTUP

Out of factory the sensor is in a special "blocked/deep sleep" mode to have as few consumption as possible of the battery. Hence the operator must wake up the device using a magnet.

The operator must pass the magnet in front of the receptive position during about 3 seconds. During magnet application the sensor emits a continuous "beep" to signal to the operator that he is in the correct position. After the 3 seconds, the sensor will emit a specific "beep sequence" signaling the wake up of the sensor : two shorts tones low then high pitched.

Then the device emits single beeps at about 2 seconds interval to signal he is trying to pair with a LoRaWAN infrastructure.

When paired the device emits twice 2 tones "low the high pitched" signaling that pairing is Ok.

For more information about possible local actions on the sensor please see §1.3.

IMPORTANT: For successful pairing on an local or global LoRaWAN network, please ensure that the device was correctly and effectively provisioned before. If it is not the case the sensor will stay in pairing mode until it discovers its network. But to save battery the pairing tries will progressively reduce to one per 24 hours.

1.3 MAIN IHM FEATURES

Different actions can be, initiated with the magnet or monitored with an audio signal locally on the sensor. Following table is a reminder for mains IHM functionalities.

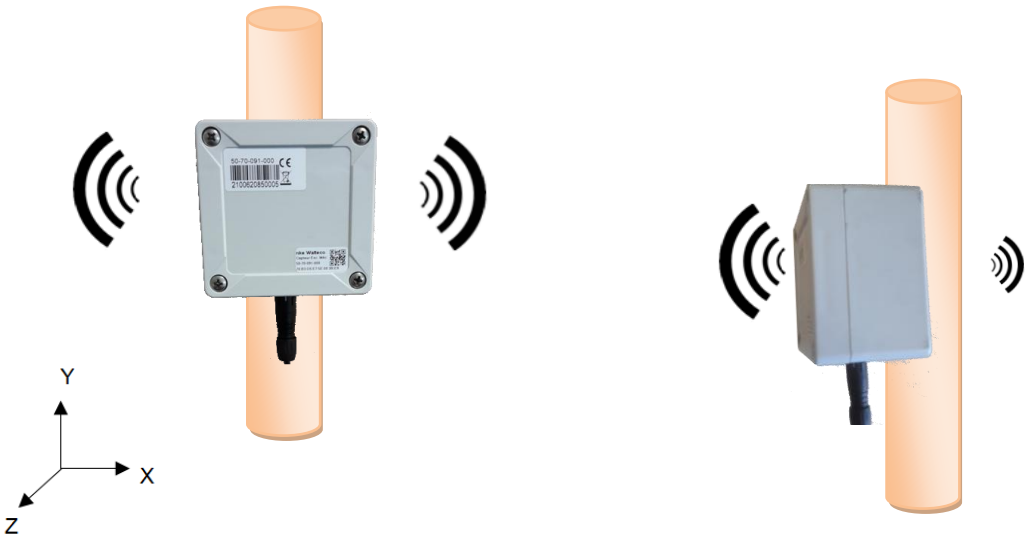
Action	Magnet	Resulting signal	Remarks
Switch ON	2 second	2 tones low then high	Association process start
Switch OFF	5 seconds	2 tones high the low	When sensor must be stop to save batery
New Association	3 times		Association restarts. Allowing to change from ABP to OTAA connexion or the opposite
Association running	-	Periodic beep at 2 seconds period	When pairing is running
Association Success	-	Twice 2 tones low then high	After correct association the sensor does not emit any more sounds
Set or Unset configuration mode	Once short when ON	Periodic beep at 2 seconds period	Configuration mode started for 10minutes
Configuration mode	-	Double beeps at 2 seconds period	Configuration mode running, one uplink sent each minutes to allow downlink communication
Factory reset of the sensor	2 short passes + one 7 seconds stay	3 times 3 beeps	The sensors reset all his current parameters (LoRaWAN and applicative configurations) to the default factory status. Then the sensor restart its association.
Magnet passes	During pass	Continuous fast beeps	

Never forget to possess a magnet when installing this kind of devices. The magnet is the main tools to interact localy with the sensor.

The sensitive part of the sensor is below the cable connector, normally labeled with the name "ILS".

1.4 RADIO PROPAGATION

In order for the sensor to function correctly, it is better to limit the number of obstacles in order to avoid excessive attenuation of the radio wave, it is also important to put the sensor as high as possible. The Intens'O device should be positioned as below to have the best radio propagation:



2 APPLICATIVE LAYER

2.1 REFERENCES

It's important to notice that software part of the sensor follows LoRaWAN specifications and nke Watteco Application Layer that are described here: http://support.nke-watteco.com. The main Intens'o functionality is decribed in http://support.nke-watteco.com/analog-input-cluster/.

This sensor supports some **new applicative functionalities** that are reminded in chapter §2.3 and fully described in **"LoRaWAN_Sensors_Application_Layer_Addon_001_V1_0.pdf"**.

2.2 SUPPORTED CLUSTERS

The Intens'o device is a sleepy Class A device. It integrates these following clusters:

Cluster	Endpoint	Cluster name	Managed attributes
0x0000	1 (0x11)	Basic	All
0x0050	1 (0x11)	Configuration	All
0x8004	1 (0x11)	LoRaWAN	All
0x000C	2 (0x31)	Analog Input	All

Notice that only Endpoint N°2 (0x31), for cluster "Analog Input" is available and manages the current measurement in Ampers.

2.3 NEW APPLICATIVE LAYER FUNCTIONALITIES SINCE NOVEMBER 2017

The document **"LoRaWAN_Sensors_Application_Layer_Addon_001_V1_0.pdf"** describes complementary functions that are available on Intens'O sensor.

As a summary here is a list of functions that extend what was available in the "analogic" cluster (0x000C), attribute "Present value"(0x0055) since November 2017.

1) Allow management of « thresholds » as standard report trigger the usual capabilitie of report trigged by "variation level" stay available

2) Up to 7 distinct criteria to can be programmed on a single attribute to trig a report.

3) Possibility to define a trigger to set an alarm flag on the report.

4) All these triggers can be factory configured or set through downlink frames.

5) Associated to each « Threshold » criteria, it's possible to set « Gap » around the thresholds to manage « hysteresis ». It is also possible to define a number of occurrences the criteria occures before trigging an alarm.

6) It is possible to require that a report contains the "reason(s)" of report.

7) It is now possible to set the LoRaWAN « confirmed » or « not confirmed » property of the report associated to some criteria. As example it allows to secure the transmission of specific alarm, even if the global LoRaWAN statu sis to send only « unconfirmed » frames.

8) Allows to compress the amount of data sent for each standard report by configuring a LoRaWAN port different from 125 duing report configuration. If done, the report will be sent without the usual mandatory header fully defining the report. Ie: the first 7 bytes of the frame (`<EP>(0x0A|0x8A)<CID><AID><Type>`) won't be sent.

9) Last, this version also adds a slight modification to "Batch report" management. The maximum number of bytes used in a batch, is now dynamically calculated according to the recommended payload size compared to currently used LoRa spreading factor.

Please refer to the **"LoRaWAN_Sensors_Application_Layer_Addon_001_V1_0.pdf"**. for more detailed description of these new functionalities.

2.4 DEFAULT PARAMETERS

Since November 2017 and as the first use cases was detection of dysfunctionnment of a specific appliance, the default parameters are set this way, for the Current value of Analogic cluster:

Genral report configuration

Parameter	Value	Note
Min Report	1 Minute	This will set the measurment period of current
Max Report	2 Hours	Kind of « heartbeat », this parameter forces at least one report each 2 hours
All report secured	No	Any « not alarm » report is sent "unconfirmed"
Secured frame if declared as alarm	Yes	Each time a report is defined as alarm it is sent "confirmed"
Report cause	Yes	Any triggered criteria is sent with report

A single trigger criteria is programmed this way

Parameter	ID	Value	Note
Threshold	0	1,5 A	This threshold is characteristic of a dysfunctionnmment in the aimed appliance
Gap	0	0,5 A	Define an hysteresis beetween 1 and 2 Amps
Occ	0	3	Number of value over threshold before trigering report
Exceed	0	Oui	Report required on rising corssing threshold
Fall	0	Oui	Report required on fallling corssing threshold
Is alarm	0	Oui	This criteria is defined as an alarm

As an example, the corresponding configuration frame is the folowing one:

```
31 06 000C E8 0055 39 8001 8078 F0 3fc00000 3f000000 03
```

2.5 EXAMPLES

2.5.1 CONFIGURING AN ALARM REPORT

In this example the user requires followin characteristics :

- Report on standard nke Watteco ZCL port 125 (containing ZCL header)
- Report secured if alarm
- Display short cause as report suffix

- Periodic Min: 5 seconds (this represent the measurment period)
- Periodic Max: 2 minutes (This is kind of Heartbeat for the cluster, at least one report each 2 minutes)

First criteria slot (N° 0):

- Report with flag alarm on falling threshold : Threshold 2A, Gap 0,5A, 3 Occurences
  In that case the minimum delay after crossing threshold is : 3 * 5s = 15s

Second criteria slot (N° 1):

- Report with flag alarm on rising threshold : Threshold 4A, Gap 0,5A, 4 Occurences
  In that case the minimum delay after crossing threshold is : 4 * 5s = 20s

Resulting configuration frame :

31 06 000c d8 0055 39 0005 8002 b0 40000000 3f000000 03 d1 40800000 3f000000 04

Deescription :

General frame format : <Ep><Cmd><CID><RP><AID><Type>
<MinR><MaxR><CSD><Val><Gap><Occ><CSD><Val><Gap><Occ>

<EP>**:** ZCL Endpoint
0x31: Current measurment for Intens'O

<Cmd> : Command
0x06 : Configure report

<CID> : Cluster ID
0x000C : Analog input cluster

<RP> : Report params
b0: 0 Not a batch
b1: 0 Normal, on prot 125 using ZCL header
b2: 0 General report not secured « confirmed »
b3: 1 Confirmed if alarm
b5-4: 01 Request short cause
b6: 1 Reserved
b7: 1 New ZCL format
==> 1110 1000 = 0xD8

<AID> : Attribute ID
0x0055 : Present value

<Type> : Type of value

0x39 : Float Single

<MinR> : Min report
0x0005 : 5 secondes

<MaxR> : Max report
0x8002 : 2 minutes

<CSD> : Criteria slot descriptor
b2-0 : 000 Slot 0
b4-3 : 10 Sur seuil
b5 : 1 On fall
b6 : 0 Not on exceed
b7 : 1 Alarm
==> 1111 0000 = 0xb0

<Val> : Threshold value
0x40000000: 2A (float Single IEE754)

<Gap> : Hysteresis around threshold value (Threshold +/- GAP)
0x3f000000: 0,5 A en (float Single IEE754)

<Occ> : Number of consecutive occurrences before triggering report
0x03 : 3 occurrences

<CSD> : Criteria slot descriptor
b2-0 : 001 Slot 1
b4-3 : 10 On threshold
b5 : 0 Not on fall
b6 : 1 On exceed
b7 : 1 Alarm
==> 1101 0001 = 0xd1

<Val> : Threshold value
0x40000000: 2A (float Single IEE754)

<Gap> : Hysteresis around threshold value (Threshold +/- GAP)
0x3f000000: 0,5 A (float single precision IEE754)

<Occ> : Number of consecutive occurrences before triggering report
0x04 : 4 occurrences

2.5.2 DECODING A RECEIVED REPORT WITH NEW FUNCTIONNALITIES

Received frame : `31 8A 000C 0055 39 412487D2 D8 D1`

General frame format : `<EP>(0x0A|0x8A)<CID><AID><Type><Value><RP><CSD>`

Decoded reporting frame is :

```
<EP> : Endpoint
  0x31: Intens'O Analog Input endpoint used for current measurment

<Cmd> : Command
  0x8A : The report is an alarm (either it would be 0x0A)

<CID> : Cluster ID
  0x000C : Analog input cluster

<AID> : Attribute ID
  0x0055 : Present value

<Type> : Type of value
  0x39 : Float single precision

<Value> : Value when report triggered
  0x412487d2 ➔ 10.283159 A

<RP> : Report params :  0xD8 : 1110 1000
  b0:   0  Not a batch
  b1:   0  Normal, On port 125 et with header
  b2:   0  Not alarm reports are not secured
  b3:   1  Secured if criteria is an alarm
  b5-4: 01 Request short cause
  b6:   1  Reserved
  b7:   1  New ZCL format

<CSD> : Criteria slot descriptor : 0xD1 : 1101 0001
  b2-0 : 001 Slot 1
  b4-3 : 10  On threshold
  b5   : 0   Has not fall
  b6   : 1   Has exceed
  b7   : 1   Is Alarm
```

3 CONSUMPTION AND LIFE EXPECTANCY

Transmission periodicity	Measurement periodicity	Battery life*
30 minutes	60 secondes	10 years

* measured at 20°C in SF12