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## DOCUMENT HISTORY

<table>
<thead>
<tr>
<th>Date</th>
<th>Revision</th>
<th>Modification Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Novembre 2017</td>
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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

Intens’o 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 current:

<table>
<thead>
<tr>
<th>Current range</th>
<th>Precision</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0,0 - 0,5A</td>
<td>- *</td>
<td>In standard configuration measuring current less than 500 mA is not possible. Then 0 A is returned. In that case user should multiply wire turns in current transformer.</td>
</tr>
<tr>
<td>0,5 - 1 A</td>
<td>30 %</td>
<td></td>
</tr>
<tr>
<td>1 - 3 A</td>
<td>10 %</td>
<td></td>
</tr>
<tr>
<td>3 - 17 A</td>
<td>2 %</td>
<td></td>
</tr>
<tr>
<td>17 - 18 A</td>
<td>10 %</td>
<td></td>
</tr>
<tr>
<td>18 - 20 A</td>
<td>20 %</td>
<td></td>
</tr>
<tr>
<td>20 - 30 A</td>
<td>30 %</td>
<td></td>
</tr>
<tr>
<td>30 - A</td>
<td>- *</td>
<td></td>
</tr>
</tbody>
</table>

* 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 TRANSFORMER 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 CONNESSION

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.

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

Never forget to possess a magnet when installing this kind of devices. The magnet is the main tools to interact locally 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](http://support.nke-watteco.com). The main Intens’o functionality is described in [http://support.nke-watteco.com/analog-input-cluster/](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:

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Endpoint</th>
<th>Cluster name</th>
<th>Managed attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x0000</td>
<td>1 (0x11)</td>
<td>Basic</td>
<td>All</td>
</tr>
<tr>
<td>0x0050</td>
<td>1 (0x11)</td>
<td>Configuration</td>
<td>All</td>
</tr>
<tr>
<td>0x8004</td>
<td>1 (0x11)</td>
<td>LoRaWAN</td>
<td>All</td>
</tr>
<tr>
<td>0x000C</td>
<td>2 (0x31)</td>
<td>Analog Input</td>
<td>All</td>
</tr>
</tbody>
</table>

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 capability of report triggered by “variation level” stay available

2) Up to 7 distinct criteria to 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 occurs 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 status is 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 during report configuration. If done, the report will be sent without the usual mandatory header fully defining the report. I.e: 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 dysfunctionment of a specific appliance, the default parameters are set this way, for the Current value of Analogic cluster:

**General report configuration**

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

**A single trigger criteria is programmed this way**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>ID</th>
<th>Value</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threshold</td>
<td>0</td>
<td>1,5 A</td>
<td>This threshold is characteristic of a dysfunctionment in the aimed appliance</td>
</tr>
<tr>
<td>Gap</td>
<td>0</td>
<td>0,5 A</td>
<td>Define an hysteresis between 1 and 2 Amps</td>
</tr>
<tr>
<td>Occ</td>
<td>0</td>
<td>3</td>
<td>Number of value over threshold before trigering report</td>
</tr>
<tr>
<td>Exceed</td>
<td>0</td>
<td>Oui</td>
<td>Report required on rising crossing threshold</td>
</tr>
<tr>
<td>Fall</td>
<td>0</td>
<td>Oui</td>
<td>Report required on falling crossing threshold</td>
</tr>
<tr>
<td>Is alarm</td>
<td>0</td>
<td>Oui</td>
<td>This criteria is defined as an alarm</td>
</tr>
</tbody>
</table>

As an example, the corresponding configuration frame is the following 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 the following 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 represents the measurement 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 occurrences
  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 occurrences
  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

Description:

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

<Ep>: ZCL Endpoint
     0x31: Current measurement 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 seconds

<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 functionalities**

**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 measurement

_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

<table>
<thead>
<tr>
<th>Transmission periodicity</th>
<th>Measurement periodicity</th>
<th>Battery life*</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 minutes</td>
<td>60 seconds</td>
<td>10 years</td>
</tr>
</tbody>
</table>

* measured at 20°C in SF12