MODBUS RS485 SENSOR

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
November 2017	1.0	First revision

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1 INTRODUCTION

This document describes the usage of the ModBus sensor. It is necessary to read the website: http://support.nke-watteco.com/ for all generic information or to have more details.

1.1 GENERAL DESCRIPTION

The ModBus sensor is a LoRaWAN class A sensor. It manages two different power supplies, one is external and may range from **9 to 24V** the other one is internal on a disposable **A 3.6V battery**. To use the external power supply, just connect a compatible one on the “Ext power” connector.

The ModBus sensor integrates all the connections needed for a RS485 bus: **A**, **B** and **GND**. It also includes an internal antenna.

FIGURE 1 - MODBUS SENSOR ILLUSTRATION

The ModBus sensor allows to communicate (throught the LoRaWAN network) with any equipment implementing the ModBus protocol as **slave**.

The ModBus equipment to communicate with, must use the **RTU coding type** and a **RS485 bus** as the physical link.
Moreover, the ModBus equipment must support at least one of the baudrates in the following list: **1200**, **2400**, **4800**, **9600**, **19200**, **38400**, **57600** or **115200 bit/s**.

If these prerequisites are fulfilled, the nke Watteco ModBus sensor is compatible with the equipment and thus can correctly communicate with it to get or set any modbus registers present inside the equipment. So, the ModBus equipment is now LoRaWAN ready thanks to the sensor.

1.2 INSTALLATION

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 product is delivered disassembled. This enables the connection to the screw terminals.

Before connecting your cable strands to the product's screw terminals, you must insert the cable gland's nut and the seal.

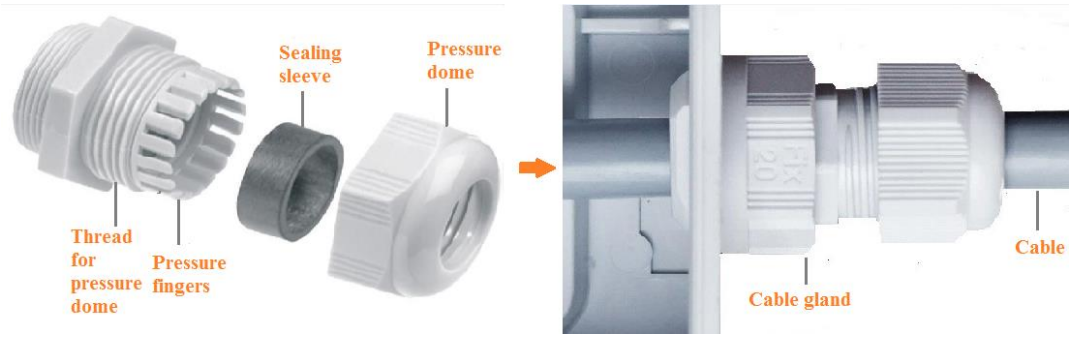

FIGURE 2 - CABLE GLAND MOUNTING

Then connect the wire on the different signals or power that will be used.

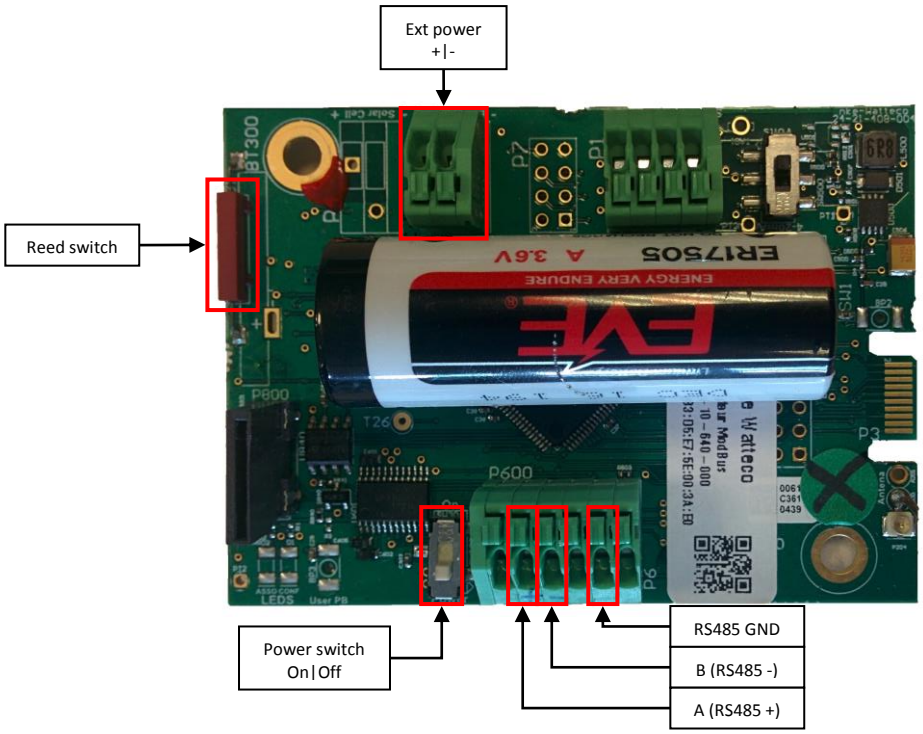

FIGURE 3 - AVAILABLE SIGNALS AND INTERACTION ON MODBUS SENSOR

For connectors, it is preferable to use several single wires with a gauge of 20-26 AWG. As the connectors pluck the wires plugged inside at about 4mm of the wire-end, strip the wires on about 5 to 6 mm of their extremity before plugging them into the connectors.

The cable to use for the RS485 communication must have some features allowing to correctly bring the signals from the ModBus sensor to the ModBus equipment. Especially when there is a long distance to cover.
Nke Watteco recommends the following cable:
https://fr.rs-online.com/web/p/cables-industriels-multipaires-torsades/7491624/

The **RS485** bus signals must be connected with the **correspondant signals on the ModBus equipment side**. The Ground signal of the RS485 is generally connected to the **shielding braid** on both sides.

Once the assembly is done, the casing can be closed.

The housing is compatible with the following DIN rail adapter:

FIGURE 4 - DIN RAIL ADAPTER

For more information about the casing, visit: www.spelsberg.com

1.3 PROPAGATION RADIO

In order for the sensor to work 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 cable gland should be positionned downward.

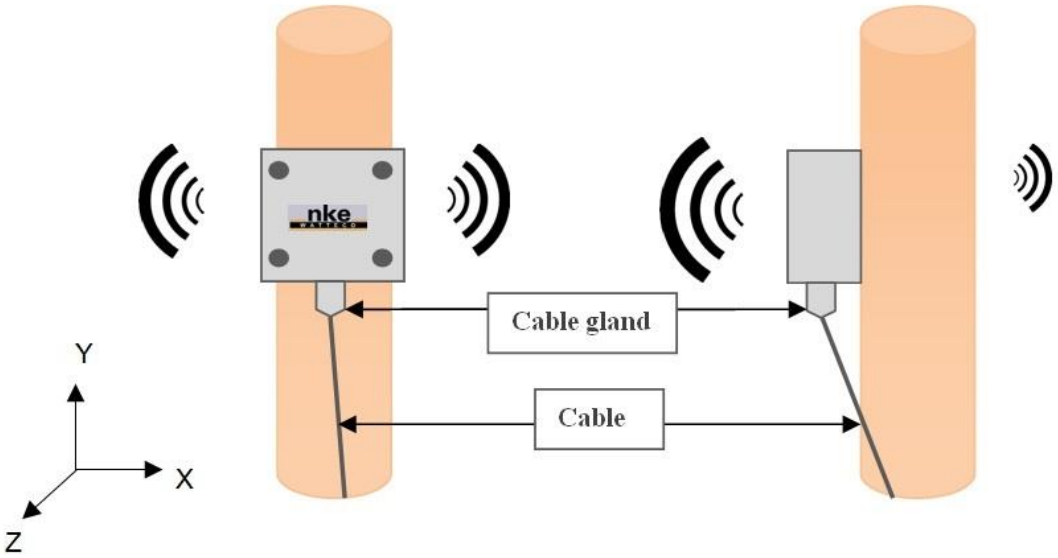

FIGURE 5 - BEST INSTALATION POSITION FOR THE MODBUS SENSOR

2 HUMAN MACHINE INTERFACE

2.1 STARTING THE MODBUS SENSOR

As it can be seen on the Figure 3, the ModBus sensor has an On/Off switch and a reed switch.

In order to start correctly the device, the On/Off switch must be put on the "On" position. If when putting the switch to "On", the device does not start beeping, it means that it is in storage mode. To get the end-device out of the storage mode, a magnet must be placed near the reed switch for 1 second, until the device start to beep regularly.

Here below can be seen the tab containing the action to do on the reed switch to get out or get in the storage mode.

Action	Magnet	Buzzer
Switch On ***(get out from storage mode)***	1 second	BiiiipBip
Switch Off ***(get in storage mode)***	5 seconds	BiiiipBip

NB: When a magnet is near the reed switch, the end-device beep fastly and continuously.

2.2 ASSOCIATION

Once the ModBus sensor started, it tries to associates itself to a LoRaWAN network. During this time it beeps regularly every 2 seconds.

At the moment of the association, the ModBus sensor beeps 4 time and then stops beeping.

Here below can be seen a tab summarizing this.

Action	Magnet	Buzzer
Association	-----	Bip-2sec-Bip
Association success	-----	BipBipBipBip

2.3 USER COMMANDS

As a reed switch (or magnetic switch) is available. It is possible to use a magnet to activate it and make specific actions on the sensor (Switch off, switch on, Re-association…).

Here below are listed the available actions on the ModBus sensor.

2.3.1 CONFIGURATION MODE

When the end-device is in this mode, it sends "void" frames every minute for 10 minutes.

Configuration Mode

Way to trigger it	One passage of the magnet near the reed switch or specific ZCL command
Way to stop it	Another passage of the magnet or specific ZCL command
Effects on the sensor	BipBiiiip-3sec- BipBiiiip
Time duration	The configuration mode lasts 10 minutes

2.3.2 RE-ASSOCIATION

It is possible to ask a ReAssociation procedure if no down frame is received by the sensor during a given periodicity (4 days by default) or if a given number (100 by default) or failure (no acquittement is received) are reached by sending an applicative frame to the sensor or by the IHM of the sensor.

The sensor keeps the AppEUi and DevAddr configured, Confirmed/Unconfirmed configuration and all applicative configurations. On the other hand, LoRaWAN configuration (channel, datarate …) are lost.

Re-Association

Way to trigger it	Three passages of the magnet near the reed switch or ZCL command from LoRaWAN cluster
Effects on the sensor	Bip-2sec-Bip (cf. association paragraph)

2.3.3 FACTORY RESET

A factory reset is available on nke Watteco's sensors. It deletes all the applicative settings saved in the flash memory (i.e.: the configured batches and reports will be deleted).

The sensor keeps the AppEUi and DevAddr configured. On the other hand, LoRaWAN configurations (channel, datarate …) and applicative configurations are lost.

Factory reset

Way to trigger it	Two quick passages and a long passage of the magnet near the reed switch
Effects on the sensor	(BipBipBip) x 3

3 CASING

Dimension:	84 * 82 * 55 mm
Combustion behaviour:	UL94HB

4 CONSUMPTION

When powered by its internal disposable battery 3.6V/3.6Ah, the ModBus sensor autonomy is higher than **10 years** for a report of **4 bytes** (**2 ModBus registers**) in **SF12** every **30 minutes**.

More examples of ModBus sensor autonomy on its disposable battery can be found here below.

Transmission periodicity	Number of ModBus registers reported	Battery life
10 min	2 or 3	4 years
30 min	2 or 3	11 years
1 hour	2 or 3	> 15 years
24 hour	2 or 3	> 15 years

5 APPLICATIVE LAYER

The ModBus device is a sleepy Class A device. It integrates the following clusters.

Cluster	*Cluster name*	*Managed attributes*
0x0000	Basic	All
0x0050	Configuration	All
0x8004	LoRaWAN	All
0x8006	Serial Interface	All
0x8007	Serial Master/Slave Protocol	All

In the ModBus sensor, the Serial Master/Slave Protocol implement 8 EndPoints. That means that up to 8 requests can be managed by the ModBus sensor, thus up to 8 reports with different configuration and different ModBus request. The different flags for each of these EndPoints are, in order: 0x11 (EP0), 0x31 (EP1), 0x51 (EP2), 0x71 (EP3), 0x91 (EP4), 0xB1 (EP5), 0xD1 (EP6) and 0xF1 (EP7).

These 8 Endpoints allow a big diversity in the exchanges between the nke Watteco's ModBus sensor and the ModBus equipment.

5.1 DEFAULT CONFIGURATION

The ModBus sensor being a very open sensor and as it is compatible with a lot of different equipment, there is no default report configuration on the "Serial Master/Slave Protocol" cluster.

For the "Serial Interface" cluster, the default values for the attributes are the following:

- **Speed** : 9600 bit/s
- **DataBits** : 8 bits
- **Parity** : None
- **StopBits** : 1 bit

5.2 MODBUS EXCHANGES PERIODICITY

The minimum ModBus exchange periodicity available is 30 seconds. If in the configuration of the report, the minimum value is set under 30 seconds, the sensor put it to 30 seconds.

The exchange periodicity depends on the minimum and the maximum interval in the report configuration.

If the minimum is set at 0 and the maximum at another value, then an exchange will be done every 30 seconds, and a report will be sent when the time reach the maximum value (if the delta is set at 0). If the delta is set at 1, a first report will be sent after 30 seconds, afterwards, a report will be send each time that the answer from the ModBus equipment changed.

If the minimum is set at a value different from 0 and above 30 seconds, then this value is the periodicity used by the sensor to send the request to the ModBus equipment.

5.3 EXAMPLES

5.3.1 CONFIGURE THE SERIAL LINK PARAMETERS

Specification: *The ModBus equipment on which the ModBus sensor is connected, use the following parameters on the serial link:*

- *Speed: 19200 bit/s*
- *Data Bits: 7 bits*
- *Parity: Even*
- *Stop Bits : 1 bit*

Solution: The solution is to configure all the serial link parameters thanks to the "Serial Interface" cluster. There is just one end-point for this cluster on the ModBus sensor, thus the End-Point is 0, we will used the "Write attribute no response" command (0x05) and the cluster ID is 0x8006. Thus, here below can be found the different payloads to send to the ModBus sensor to correctly configure the serial link (on the FPort 125). It can be seen that the payload to change the stop bit is here. Nevertheless in reality it is not necessary since 1 bit it's its default value.

Speed change: 11 05 8006 0000 22 004B00

- Attribute ID 0x0000 (Speed)
- Attribute Type 0x22 (UINT24_TYPE)
- New value for the attribute 0x004B00 (19200 bits/s)

Data bits change: 11 05 8006 0001 20 07

- Attribute ID 0x0001 (DataBits)
- Attribute Type 0x20 (UINT8_TYPE)
- New value for the attribute 0x07 (7 bits)

Parity change: 11 05 8006 0002 20 02

- Attribute ID 0x0002 (Parity)
- Attribute Type 0x20 (UINT8_TYPE)
- New value for the attribute 0x02 (Even Parity)

Stop bits change: 11 05 8006 0003 20 01

- Attribute ID 0x0003 (StopBits)
- Attribute Type 0x20 (UINT8_TYPE)
- New value for the attribute 0x01 (1 bit)

5.3.2 SAVE A MODBUS REQUEST ON THE SECOND END-POINT

Specification: *Save a ModBus request on the second End-Point of the ModBus sensor allowing to read 2 registers of the ModBus equipment form the address 0x140. The ModBus address of the equipment (thus, the ModBus slave address) is 0x23.*

Solution: The solution is to configure the request (Attribute ID: 0x0000) to use on the 2nd End-Point (0x31) thanks to the command "Write Attribute No Response" (0x05), in the cluster "Serial Master/Slave Protocol" (0x8007)

Applicative payload is: 31 05 8007 0000 41 06 230301400002

- Attribute ID 0x0000 (Request)
- Attribute Type 0x41 (BYTES_STRING)
- Bytes string size 0x06 (6 bytes)
- ModBus Request (without CRC) : 23 03 0140 0002
  - ModBus Slave Address : 0x23
  - ModBus Command : 0x03 (Read Holding Registers)
  - ModBus register address : 0x0140
  - Number of registers to read : 0x0002

For more details about the differents ModBus command, please refers to the ModBus Application Protocol Specification, available on the official ModBus website:

http://www.modbus.org/docs/Modbus_Application_Protocol_V1_1b.pdf

5.3.3 CONFIGURE A REPORT OF THE MODBUS SLAVE ANSWER EVERY 1H ON THE SECOND END-POINT

Specification: *Now that the request on the second End-Point has been correctly saved (see §5.3.2), we want to report the answer of the ModBus slave to this request every 1 hour. In other word, we want to have the content of the 0x0140 and 0x0141 ModBus register every 1 hour.*

Solution: The solution is to configure a report with the command "Configure reporting" (0x06), on the second End-Point (0x31) of the cluster "Serial Master/Slave Protocol" (0x8007), on the Attribute "Answer" (0x0001) with a periodicity of one hour.

Applicative payload is: 31 06 8007 00 0001 41 803C 803C 01 00

- Attribute ID 0x0001 (Answer)
- Attribute Type 0x41 (BYTES_STRING)
- Minimum reporting interval 0x803C (60 minutes or 1 hour)
- Maximum reporting interval 0x803C (60 minutes or 1 hour)
- Reportable change 0 (A change in the ModBus answer do not trig a report to be sent)