

LoRaWAN MODBUS MASTER

Transceiver Modbus Interface

User Guide
Version 1.0.0



NEW DOCUMENTATION

ENGLISH

USER GUIDE

- **Dedicated to a product**
- Cautions & electrical warnings
- Declaration of conformity
- Product functionalities and modes
- Casing dimensions
- Characteristics (casing and electrical)
- LED explanations
- Specific wiring on terminal blocks

TECHNICAL REFERENCE MANUAL

- **Dedicated to a product**
- Registers content
- Frame explanations (uplink and downlink)

INSTALLATION GUIDE

- **For all adeunis® products**
- Configuration of the products
- Installation and fixing
- Start-up of the products
- Opening and closing the case
- Replace battery

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Préambule / Preamble / Präambel / Preambolo / Preámbulo

- Ce guide décrit les fonctionnalités du produit adeunis®. Il explique les modes de fonctionnement du produit et la manière de le configurer.
- This guide describes the functionalities of the product adeunis®. It explains its functionments and how to configure it.
- Dieser Leitfaden beschreibt die Funktionalität des Produktes adeunis®. Er erklärt die Betriebsfunktionen des Produktes und die Art und Weise, um es zu konfigurieren.
- Questa guida descrive la funzionalità del prodotto adeunis®. Questo spiega come funziona il prodotto e come configurarlo.
- Esta guía describe las funcionalidades del producto adeunis®. En él se explica los modos de funcionamiento del producto y cómo configurarlo.
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TABLE OF CONTENT

NEW DOCUMENTATION	2
PRODUCTS AND REGULATORY INFORMATION	5
1. PRODUCT PRESENTATION	10
1.1. General description	10
1.2. Dimensions	11
1.3. Electronic board	11
1.4. Technical Specifications	12
1.4.1 General characteristics	12
1.4.2 Characteristics of physical interfaces	12
2. PRODUCT OPERATION	13
2.1. Global Operation	13
2.1.1 PARK mode	13
2.1.2 COMMAND mode	13
2.1.3 PRODUCTION mode	13
2.2. Application operation	14
2.2.1 Periodic transmission	14
2.2.2 Transmission on exceeding of the threshold	15
2.2.3 Transmission on exceeding of the threshold, with alarm repetition	17
2.2.4 Transmission of a daily Keep Alive frame	18
2.2.5 Transmission of the response frame following a «reading register slave» request	18
2.2.6 Transmission of the acknowledgment following a “write in a slave register” request	18
2.3. Operation of the LEDs	19
3. REGISTERS AND FRAMES	20
4. CONFIGURATION AND INSTALLATION	20
4.1. Configuration and installation of the transmitter	20
4.2. Modbus specificities in the IoT Configurator	20
4.2.1 Test Modbus read, test reading into slave registers	20
4.2.2 Test Modbus write, test the writing into a slave register	20
4.3. Cables description	21
4.4. Link configuration	21
4.5. 2-wire RS485 example of wiring	21
4.6. RS232 example of wiring	22
4.7. LED an help to install	22
5. DOCUMENT HISTORY	22

EN

PRODUCTS AND REGULATORY INFORMATION

Document Information	
Title	LoRaWAN MODBUS MASTER - User Guide
Sub-title	/
Document type	User Guide
Version	1.0.0

This document applies to the following products :

Nom	Référence	Version firmware
LoRaWAN MODBUS MASTER	ARF8240BA	Version RTU : V1.7.1 Version APP : V2.0.0

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TECHNICAL SUPPORT

Website

Our website contains a lot of useful information: information on modules and wireless modems, user guides, and configuration software and technical documents which can be accessed 24 hours a day.

E-mail

If you have technical problems or cannot find the required information in the provided documents, contact our Technical Support on our website, section « Technical Support ». This ensures that your request will be processed as soon as possible.

Helpful Information when Contacting Technical Support

When contacting Technical Support, please have the following information ready:

- Product type
- Firmware version (for example V1.0)
- A clear description of your question or the problem
- A short description of the application

COMPLIANCE TO FCC US/CAN

This device complies with part 15 of the FCC rules and Industry Canada licence-exempt RSS standard(s).

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 of the device.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction, may cause harmful interference to radiocommunication. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures :

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

CHANGES OR MODIFICATIONS NOT EXPRESSLY APPROVED BY ADEUNIS COULD VOID THE USER'S
AUTHORITY TO OPERATE THE EQUIPMENT.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lower) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be chosen so that the equivalent isotropically radiated power (e.i.r.p.) is not superior than necessary for successful communication.

Mobile device :

This device complies with FCC RF radiation exposure limits set forth for general population. This device must be installed to provide a separation distance of at least 20cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

Identification :

- Contains FCC ID : U3Z-ARF8133
- Contains IC : 7016A-ARF8133

Product reference: USA/CANADA: ARF8240B

Authorised representative in Canada

X Telia

440 rue Ste-Hélène, J4K 3R2, Longueuil (Québec) – CANADA

INTRODUCTION

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ENVIRONMENTAL RECOMMENDATIONS

All superfluous packaging materials have been eliminated. We have done everything possible to make it easy to separate the packaging into three types of materials: cardboard (box), expanded polystyrene (filler material) and polyethylene (packets, foam protective sheets). Your device is composed of materials that can be recycled and reused if it is dismantled by a specialist company. Please observe local regulations concerning the manner in which waste packaging material, used batteries and your obsolete equipment are disposed of.

WARNINGS

Valid for products indicated in the declaration of conformity



Read the instructions in the manual.



The safety of this product is only guaranteed when it is used in accordance with its purpose. Maintenance should only be carried out by qualified persons.



Risk of explosion if the battery is removed with an incorrect type. Contact Adeunis for more information if needed.



Risk of explosion if the battery is replaced by an incorrect type

Please note: Do not install the equipment close to a heat source or in damp conditions.

Please note: When the equipment is open, do not carry out any operations other than the ones set out in this document.



Please note: Do not open the product as there is a risk of electrical shock.



Please note: For your own safety, you must ensure that the equipment is switched off before carrying out any work on it.



Please note: For your own safety, the power supply circuit must be SELV (Safety Extra Low Voltage) and must be from limited power sources.

Please note: When the aerial is installed outside, it is essential to connect the cable screen to the building's earth. We recommend using lightning protection. The protection kit chosen must permit the coaxial cable to be earthed (eg: coaxial lightning arrester with earthing of the cable at different places on the aerial at the base of pylons and at the entrance, or just before entering the premises).


RECOMMANDATIONS REGARDING USE

- Before using the system, check that the power supply voltage shown in the user manual corresponds to your supply. If it doesn't, please consult your supplier.
- Place the device against a flat, firm and stable surface.
- The device must be installed in a location that is sufficiently ventilated so that there is no risk of internal heating and it must not be covered with objects such as newspapers, cloths, curtains, etc.
- The device's aerial must be free and at least 10 cm away from any conducting material.
- The device must never be exposed to heat sources such as heating equipment.
- Do not place the device close to objects with naked flames such as lit candles, blowtorches, etc.
- The device must not be exposed to harsh chemical agents or solvents likely to damage the plastic or corrode the metal parts.

DISPOSAL OF WASTE BY USERS IN PRIVATE HOUSEHOLDS WITHIN THE EUROPEAN UNION



This symbol on the product or on its packaging indicates that this product must not be disposed of with your other household waste. Instead, it is your responsibility to dispose of your waste by taking it to a collection point designated for the recycling of electrical and electronic appliances. Separate collection and recycling of your waste at the time of disposal will contribute to conserving natural resources and guarantee recycling that respects the environment and human health. For further information concerning your nearest recycling centre, please contact your nearest local authority/town hall offices, your household waste collection company or the shop where you bought the product

 This symbol on the device or its packaging means the use of a DC voltage.

1. PRODUCT PRESENTATION

Description:

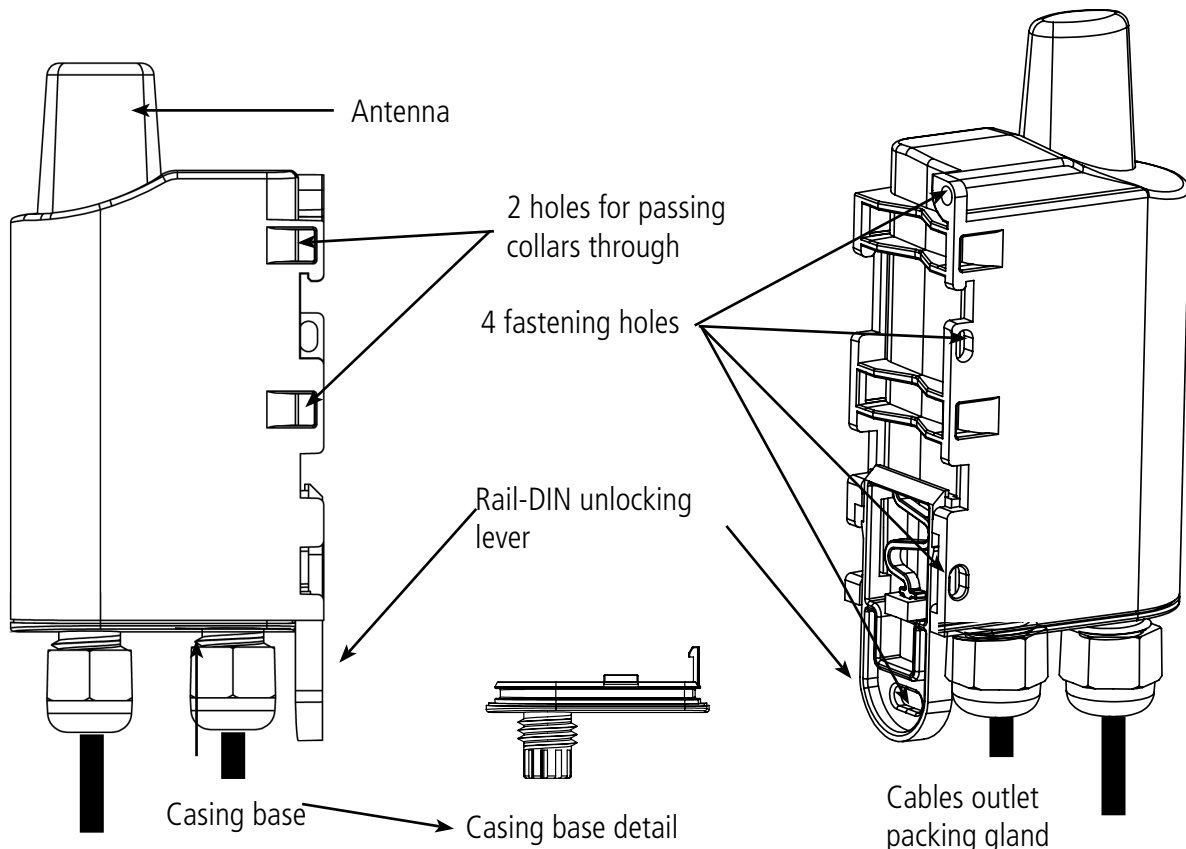
- The adeunis® LoRaWAN MODBUS MASTER is a ready-to-use radio transmitter with a MODBUS interface
- This product meets the needs of users to communicate with one or several MODBUS slaves and transmit their information via a LoRaWAN network.
- The product use the **Remote Terminal Unit (RTU)** Modbus protocol to communicate with the slaves.
- The frame of the product can contain 24 registers (of 2 bytes) maximum per periodic frame. These registers can be distributed between the monitored slaves (20 slaves maximum) knowing that for each slave 15 registers can be configured per frame.
- The product **transmits the data from the slaves periodically through one or several frames** (up to 6) with the same or different periods of transmission.
- The product transmits the data from slave either **periodically or in an event-related way based on high or low thresholds**.
- The product is able **to read or write in the registers** of a slave through the network.
- The configuration of the transmitter is accessible by the user via a micro-USB port or remotely via the LoRaWAN network, allowing in particular a choice of modes of transmission, periodicity or triggering thresholds.
- The LoRaWAN MODBUS MASTER is powered by an external power supply (not included).
- The product is able to provide and control the power supply for a slave.

IMPORTANT NOTE: The LoRaWAN MODBUS MASTER is delivered by default with OTAA configuration, allowing the user to declare his/her product to a LoRaWAN operator.

Composition of the package

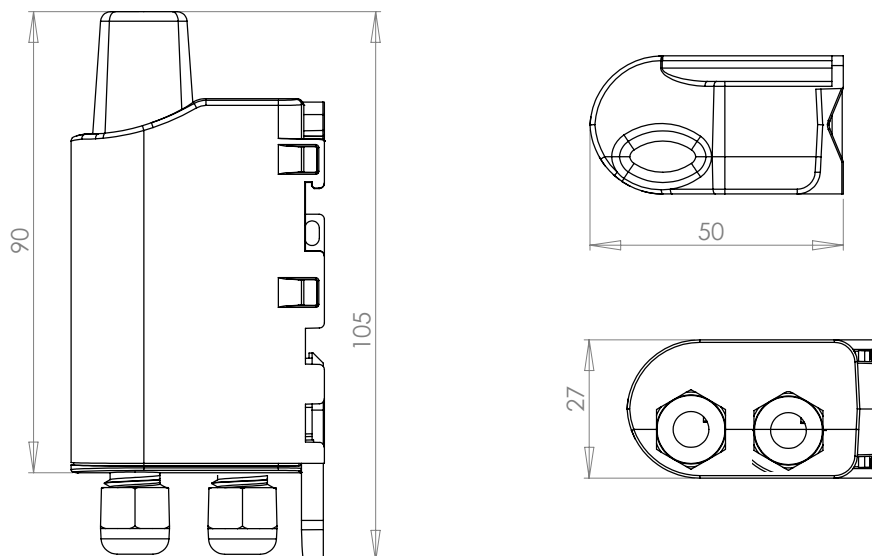
The product is supplied in a cardboard box containing the following items:
top casing, electronic card, casing base plate,
Cable gland, 3 gland seals, 2 CBLZ 2.2 x 19mm screws, 2 Fischer SX4 plugs

1.1. General description



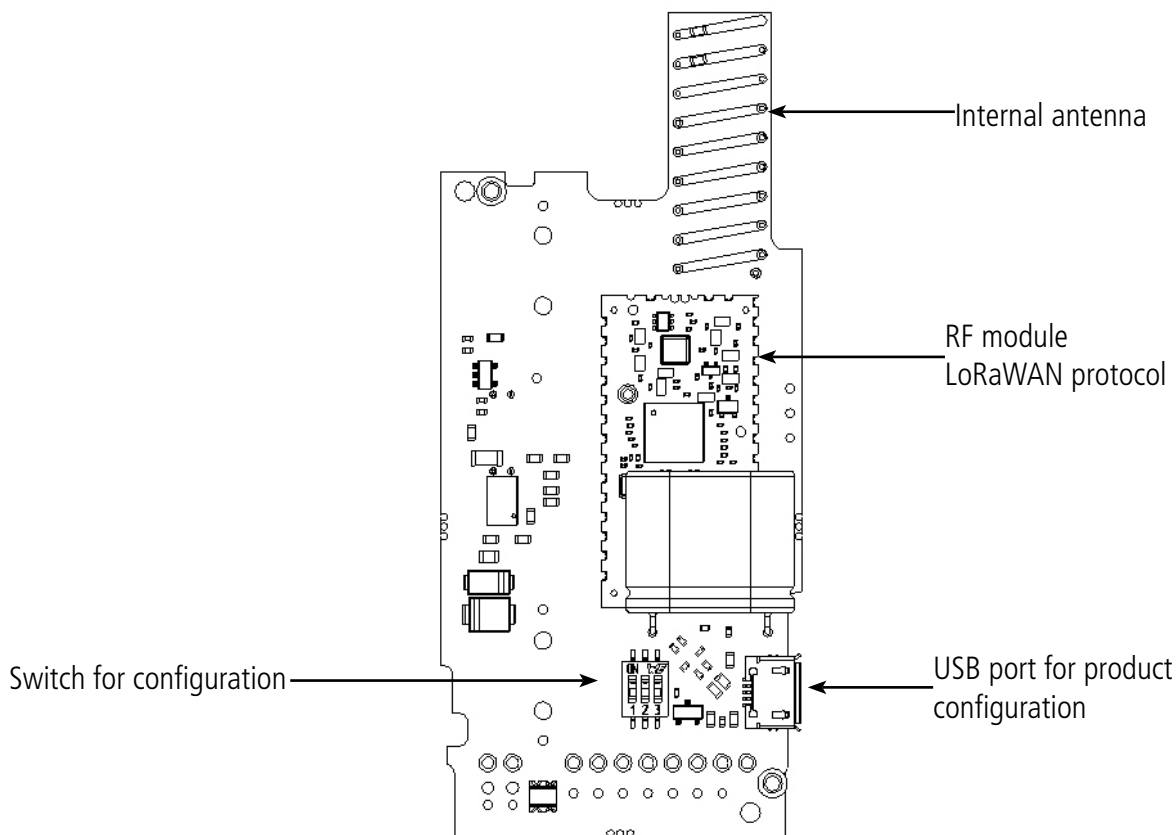
1.2. Dimensions

Values in millimeters



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1.3. Electronic board



1.4. Technical Specifications

1.4.1 General characteristics

Parameters	VALUE
Supply	DC 6-30V
Maximum supply	90mA
Working temperature	-25°C / +70°C
Dimensions	105 x 50 x 27mm
Weight	70g
Casing	IP 67
MODBUS protocol used	Remote Terminal Unit (RTU)
LoRaWAN zone	US902-928
LoRaWAN specification	1.0.2
Transmitting power	20 dBm
Applicative port of the product (downlink)	1

1.4.2 Characteristics of physical interfaces

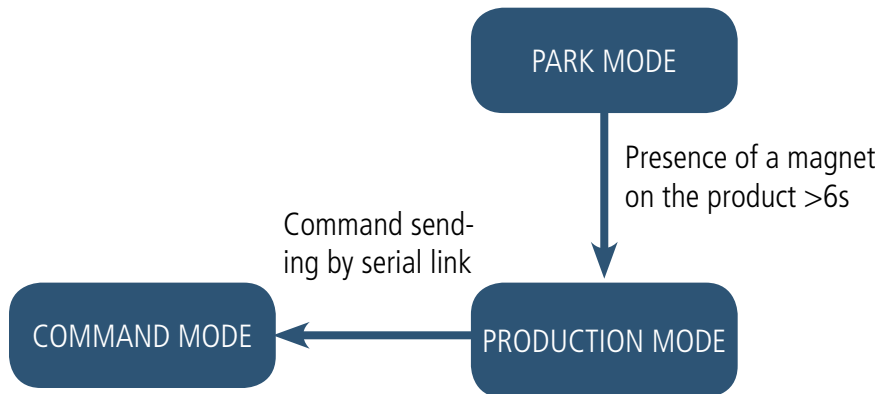
Parameters	VALUE
Cables length	70cm
Number of wires on power cable	2 wires: +V, GND
External power supply voltage	DC 6-30V
Number of wires of sensor (slave) cable	6 wires : RTS/TX-, CTS/RX-, RX/RX+, TX/TX+, Ground, Sensor power supply
RS232	3 useful signals: RX, TX, Ground (RTS and CTS are not handled) Voltages shown are common mode voltages. Voltages on inputs/outputs: +/-5V typ +/-15V max
RS485	5 useful signals : TX-, RX-, RX+, TX+, Ground Voltages shown are common mode voltages. The product is master of the link: the slave must not inject voltage on the bus! Voltages on inputs/outputs: +/-1.5V typ (3V differential) Polarization resistors: 560 Ohms Termination resistor: 120 Ohms
Sensor (slave) power supply	= External power supply voltage
Current max returned to the sensor (provided that the power supply used can provide this current)	500 mA

2. PRODUCT OPERATION

2.1. Global Operation

Important: adeunis® use the most significant byte first format.

The product has several operating modes:



2.1.1 PARK mode

The product is delivered in PARK mode, it is in standby mode and its consumption is minimal. To switch the product out of the Park* Mode pass a magnet across it for a duration higher than 6 seconds. The green LED illuminates to indicate the detection of the magnet and then flashes quickly during the product starting phase.

The device then sends its configuration and data frames.

2.1.2 COMMAND mode

This mode allows the user to configure the registers of the product.

To enter this mode, connect a cable to the micro-USB port of the product and choose to use the IoT Configurator or to use the command mode by an AT command. The exit of the COMMAND mode can be done with an ATO command or unplugging the USB cable.

The product will turn into the configured mode, PARK or PRODUCTION.

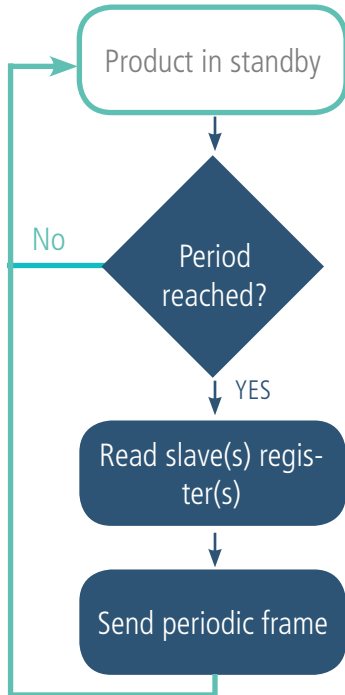
2.1.3 PRODUCTION mode

This mode allows the user to operate the product in its final use.

2.2. Application operation

2.2.1 Periodic transmission

The product allows the measurement and the periodic transmission of the VALUE s of the sensors according to the following diagram:



The product can send up to 6 different periodic frames with different transmission period configurable :

- Frame 0x44 being frame 1
- Frame 0x5F being frame 2
- Frame 0x60 being frame 3
- Frame 0x61 being frame 4
- Frame 0x62 being frame 5
- Frame 0x63 being frame 6

The parameters associated with this mode of operation are:

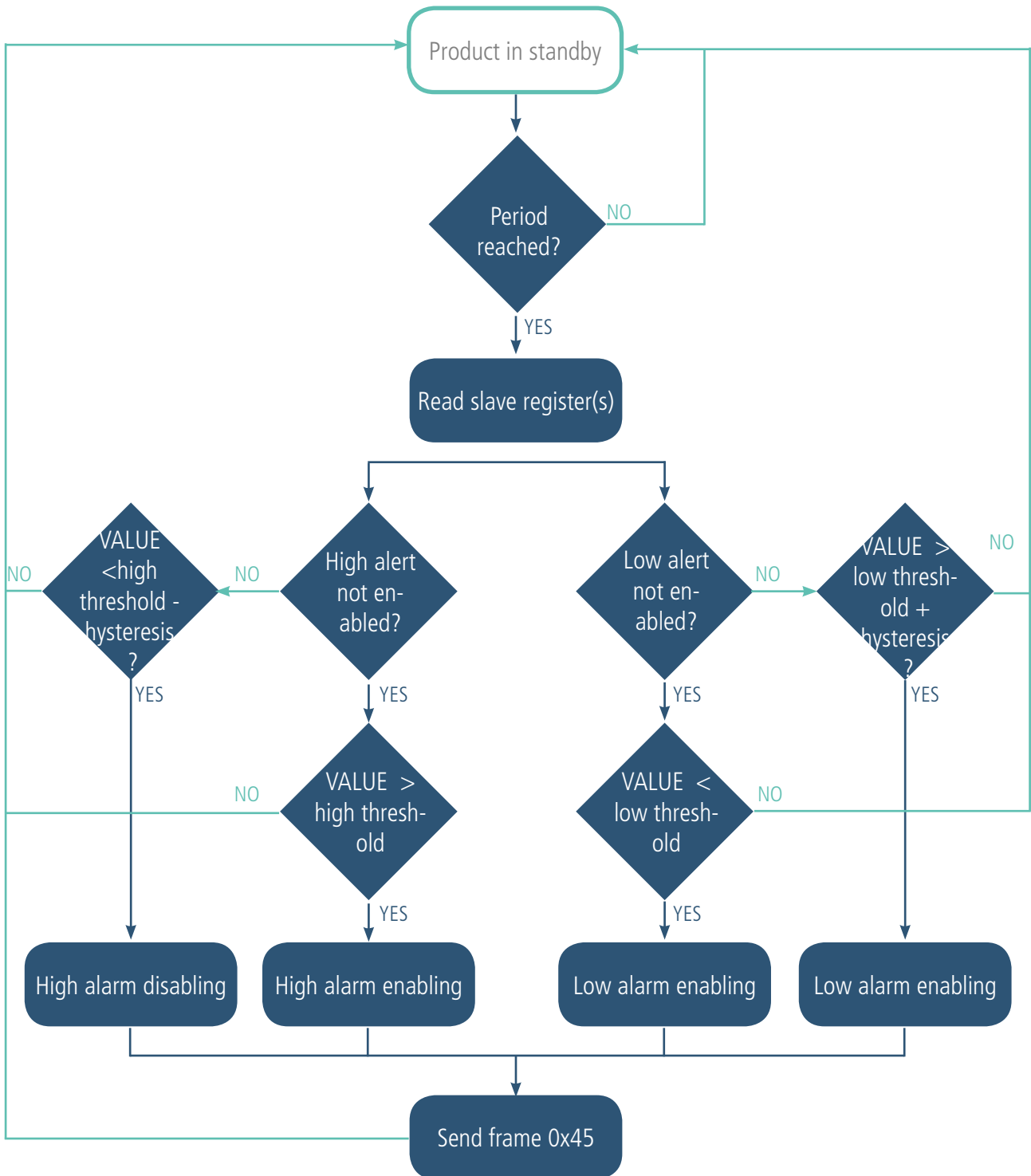
- Transmission period (register S301 or S323, S324, S325, S326, S327 depending on the concerned frame)
- External load supply time before the Modbus request (register S322)
- Definition of periodic data (registers S330 to S349)

Example:

Register	VALUE encoding	VALUE	Result
S301	Decimal	360	Periodic mode with a period of 360x10s = 3600 seconds = 1 hour
S322	Decimal	200	The supply time of the external load (slave) before the Modbus request is 200 x 100 = 20 000ms ie 20s
S330	Hexadecimal	0x01151812	Periodic data 1 configuration: <ul style="list-style-type: none"> • Slave address = 0x01 • First register address = 0x1518 • Periodic frame chosen = Periodic frame 1 • Modbus registers type : holding registers • Number of registers = 2
S331	Hexadecimal	0x570ED814	Periodic data 1 configuration: <ul style="list-style-type: none"> • Slave address = 0x57 • First register address = 0x0ED8 • Periodic frame chosen = Periodic frame 1 • Modbus registers type : input registers • Number of registers = 4

2.2.2 Transmission on exceeding of the threshold

The product allows the reading of MODBUS slave registers and the comparison of these data with thresholds (top and bottom) in order to transmit overflow information according to the following diagram:



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There will be as many alarm frames transmitted as VALUE s read on the slave registers exceeding the configured thresholds.

The settings associated with this mode of operation are:

- Acquisition period (register S320)
- Supply time of the external load (slave) before the Modbus request (register 322)
- Alarms configuration (registers S350, 355, 360, 365, 370, 375, 380, 385, 390, 395).
- High threshold alarms (registers S351, 356, 361, 366, 371, 376, 381, 386, 391, 396).
- Hysteresis of high threshold alarms (registers S352, 357, 362, 367, 372, 377, 382, 387, 392, 397).
- Low threshold alarms (registers S353, 358, 363, 368, 373, 378, 383, 388, 393, 398).
- Hysteresis of low threshold alarms (registers S354, 359, 364, 369, 374, 379, 384, 389, 394, 399).

The complete list of registers can be found in paragraph 3.4.

E.g.:

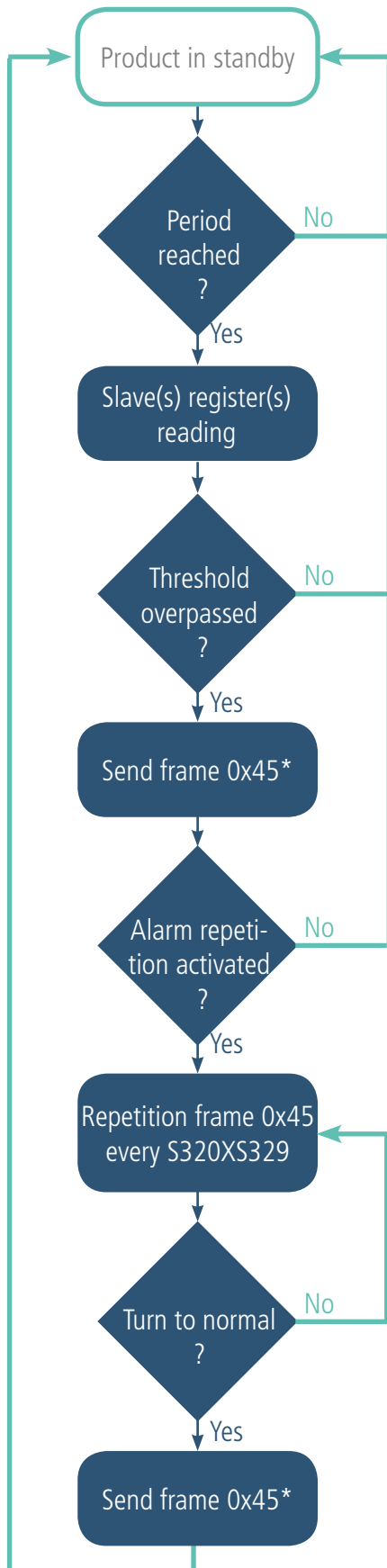
Register	VALUE encoding	VALUE	Result
S320	Decimal	360	Periodic mode with a period of $360 \times 10s = 3\,600$ seconds = 1hour
S322	Decimal	200	The supply time of the external load (slave) before the Modbus request is $200 \times 100ms = 20\,000ms$ ie 20s
S350	Hexadecimal	0x0A106827	Alarm 1 configuration: <ul style="list-style-type: none"> • Slave address = 0x0A • First register address = 0x1068 • Data type : 32-bit unsigned integer (bits 4 to 6 = 2) • Modbus register type: input registers (bit 2 = 1) • Active thresholds: low and high (bits 0 to 1 = 3)
S351	Hexadecimal	0x00124F80	High threshold of alarm 1 is 1,200,000 (decimal)
S352	Hexadecimal	0x2710	Hysteresis of high threshold of alarm 1 is 10,000 (decimal)
S353	Hexadecimal	0x00061A80	Low threshold of alarm 1 is 400,000 (decimal)
S354	Hexadecimal	0x2710	Hysteresis of low threshold of alarm 1 is 10,000 (decimal)

IMPORTANT : alarms and thresholds are set to a maximum of 4 bytes (ie 2 maximum Modbus registers).

For a value defined on one register, the user can choose the data type between unsigned or signed 16-bit integer. For a value defined on 2 registers, the user can choose the type of data between: unsigned 32-bit integer or signed 32-bit integer or unsigned 32-bit integer (word swap) or signed 32-bit integer (word swap).

2.2.3 Transmission on exceeding of the threshold, with alarm repetition

The product sends alarm frame on exceeding thresholds and to repeat this alarm regarding a configurable period (register S320 x S329) while the alarm is still active.



There will be as many alarm frames transmitted as VALUE s read on the slave registers exceeding the configured thresholds.

The settings associated with this mode of operation are:

- Acquisition period (register S320)
- Supply time of the external load (slave) before the Modbus request (register 322)
- Alarms configuration (registers S350, 355, 360, 365, 370, 375, 380, 385, 390, 395).
- High threshold alarms (registers S351, 356, 361, 366, 371, 376, 381, 386, 391, 396).
- Hysteresis of high threshold alarms (registers S352, 357, 362, 367, 372, 377, 382, 387, 392, 397).
- Low threshold alarms (registers S353, 358, 363, 368, 373, 378, 383, 388, 393, 398).
- Hysteresis of low threshold alarms (registers S354, 359, 364, 369, 374, 379, 384, 389, 394, 399).
- Alarm repetition (register S329)

E.g.:

Register	Encoding	VALUE	Result
S320	Decimal	360	Periodic mode with a period of 360x10s = 3 600 seconds = 1hour
S322	Decimal	200	The supply time of the external load (slave) before the Modbus request is 200 x100ms= 20 000ms ie 20s
S350	Hexadecimal	0x0A106827	Alarm 1 configuration: <ul style="list-style-type: none"> • Slave address = 0x0A • First register address = 0x1068 • Data type : 32-bit unsigned integer (bits 4 to 6 = 2) • Modbus register type: input registers (bit 2 = 1) • Active thresholds: low and high (bits 0 to 1 = 3)
S351	Hexadecimal	0x00124F80	High threshold of alarm 1 is 1,200,000 (decimal)
S352	Hexadecimal	0x2710	Hysteresis of high threshold of alarm 1 is 10,000 (decimal)
S353	Hexadecimal	0x00061A80	Low threshold of alarm 1 is 400,000 (decimal)
S354	Hexadecimal	0x2710	Hysteresis of low threshold of alarm 1 is 10,000 (decimal)

IMPORTANT : alarms and thresholds are set to a maximum of 4 bytes (ie 2 maximum Modbus registers).

For a value defined on one register, the user can choose the data type between unsigned or signed 16-bit integer. For a value defined on 2 registers, the user can choose the type of data between: unsigned 32-bit integer or signed 32-bit integer or unsigned 32-bit integer (word swap) or signed 32-bit integer (word swap).

*The status byte «state of the alarm» inform you about if the alarm is active or not. This information enables you to dissociate a 0x45 frame when the alarm is active or still active from a frame 0x45 that informs you that the alarm is deactivated («back to normal»).

2.2.4 Transmission of a daily Keep Alive frame

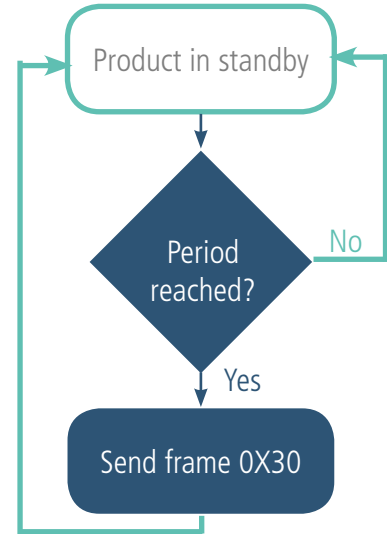
If the product has no periodic data configured, a Keep Alive frame (0x30) is transmitted regularly according to the diagram.

The settings associated with this mode of operation are:

- The setting of the period of transmission of the Keep Alive frame (register 300).

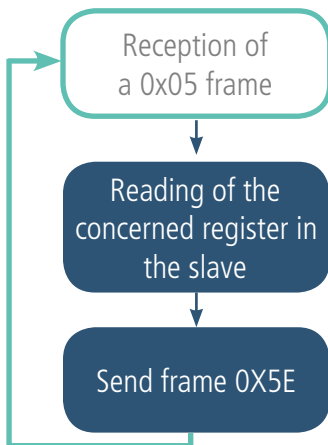
E.g.:

Register	Encoding	VALUE	Result
S300	Decimal	8640	The Keep Alive frame is sent every: 8640 x10s= 24h (once per day)



2.2.5 Transmission of the response frame following a «reading register slave» request

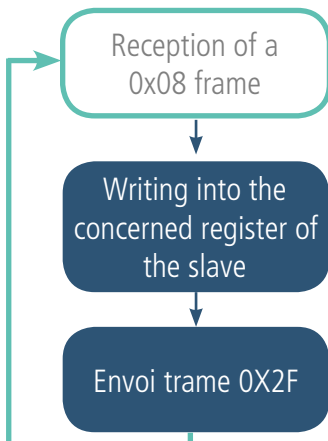
This frame is sent in response to a downlink request to read registers in a Modbus slave (0x05).



If the request is false or there is an error during reading, this frame will be empty.

2.2.6 Transmission of the acknowledgment following a "write in a slave register" request

This frame is sent following the reception of a downlink frame (0x08) to write into the register of a Modbus slave. This frame contains the information about the status of the request (success, modbus error, invalid request error).



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2.3. Operation of the LEDs

Mode	LED red state	LED green state
Product in Park mode	OFF	OFF
Magnet detection process (1 to 6 seconds)	OFF	ON from detection of the magnet up to a maximum of 1 second
Product start (after detection of the magnet)	OFF	Rapid flashing 6 cycles, 100 ms ON / 100 ms OFF
Joining process (Lora product)	During the JOIN phase: flashing: 50ms on / 1 s off If the JOIN phase is complete (JOIN accept): flashing: 50ms on / 50ms Off (6x)	During the JOIN phase: flashing: 50ms on / 1 s off (just after the red LED) If JOIN phase is complete (JOIN accept): flashing: 50ms on / 50ms off (just before the red LED)
Detection of the good communication between the product Modbus and slaves	10 seconds ON if a default is detected	10 seconds ON if no default detected
Switching to the Command mode	Continuously lit	Continuously lit
Product faulty (return to factory)	Fixed ON	

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3. REGISTERS AND FRAMES

To know the content of all the registers and for each frame of the product (uplink or downlink) please refer to the TECHNICAL REFERENCE MANUAL of the LoRaWAN MODBUS MASTER, available on the dedicated product page: <https://www.adeunis.com/en/produit/modbus-interface-for-modbus-slaves/>

4. CONFIGURATION AND INSTALLATION

4.1. Configuration and installation of the transmitter

To configure the product locally, it is advised to use the IoT Configurator, an android and windows application created by adeunis.

- Google Play : <https://play.google.com/store/apps/details?id=com.adeunis.IoTConfiguratorApp>

- Windows 10: <https://www.adeunis.com/en/downloads/>

The product can be configured locally or remotely through the network sending it specific downlink frames. To know which frame use or the format of each frame, please refer to the TECHNICAL REFERENCE MANUAL of the LoRaWAN MODBUS MASTER, available on the dedicated product page: <https://www.adeunis.com/en/produit/modbus-interface-for-modbus-slaves/>

If you want to configure your product through AT command or know how to install your product, refer to the INSTALLATION GUIDE adeunis®.

4.2. Modbus specificities in the IoT Configurator

4.2.1 Test Modbus read, test reading into slave registers

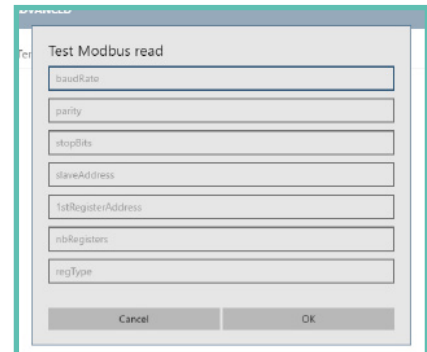
To help to configure or install the MODBUS product, a function to test the reading of a slave has been integrated into the advanced mode of the IoT Configurator.

Before having wired the product to one or several slaves, it is possible to test the reading into registers of a slave completing the following fields :

- Baud Rate
- Parity
- Stop bits
- Slave address
- First register address
- Number of registers
- Type of registers (holding or input)

The product will test the link and the reading into registers and will show you the response from the slave.

This function enables you to confirm a configuration before to implement it into the product and switch it to PRODUCTION mode.



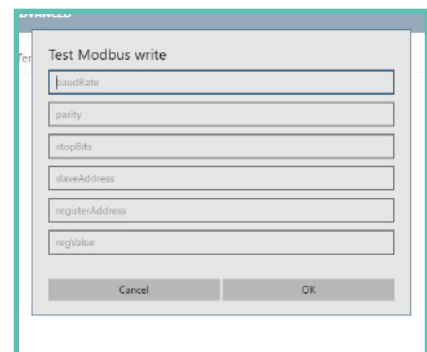
4.2.2 Test Modbus write, test the writing into a slave register

To help to configure or install the MODBUS product, a function to test writing into the register of a slave has been integrated into the advanced mode of the IoT Configurator.

Before having wired the product to one or several slaves, it is possible to test the writing function of the product completing the following fields:

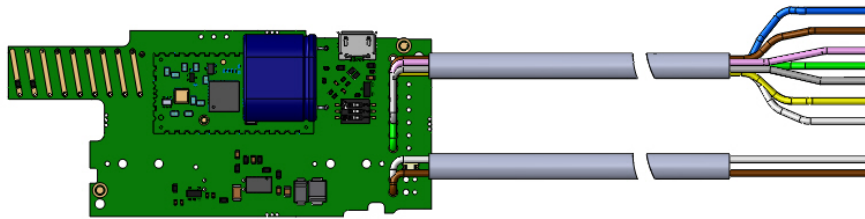
- Baud Rate
- Parity
- Stop bit
- Slave address
- Register address
- Value to write into the register

The product will test the link and the writing into the concerned register and will show you the response from the slave.



This function enables you to confirm the link between the device and the slave register or to write directly in a slave register.

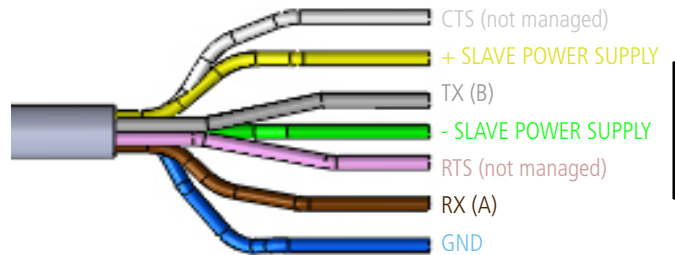
4.3. Cables description



Cable with 2-wire for supply



Cable with 7-wire



4.4. Link configuration

The Modbus physical layer supports a RS485 (default) or RS232 serial link. The bit 0 of register 321 allows to configure this choice :

- Bit 0 = 0 (default): RS485
- Bit 0 = 1: RS232

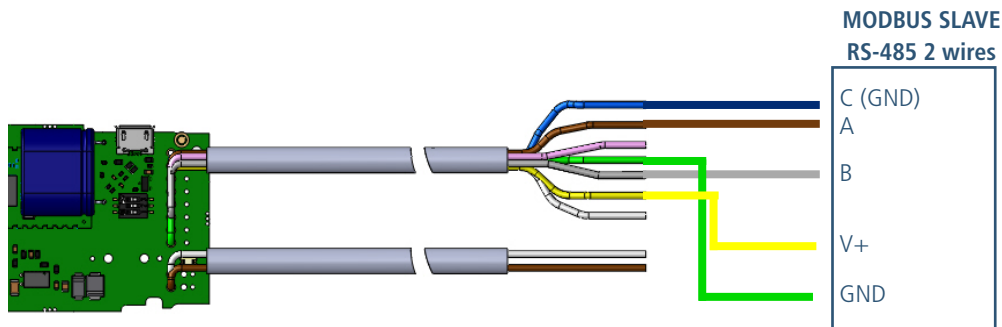
On the other hand, a 3-way switch present on the electronic board allows the configuration of the end-of-line resistor and the RS485 bus polarization:

- Switch 1 = ON (RS-485 bus end-of-line resistor)
- Switches 2 and 3 = ON (RS-485 bus polarization)

The default switch configuration is all channels ON.

Important: in case of RS232 configuration, the 3 channels of the switch must be set to OFF.

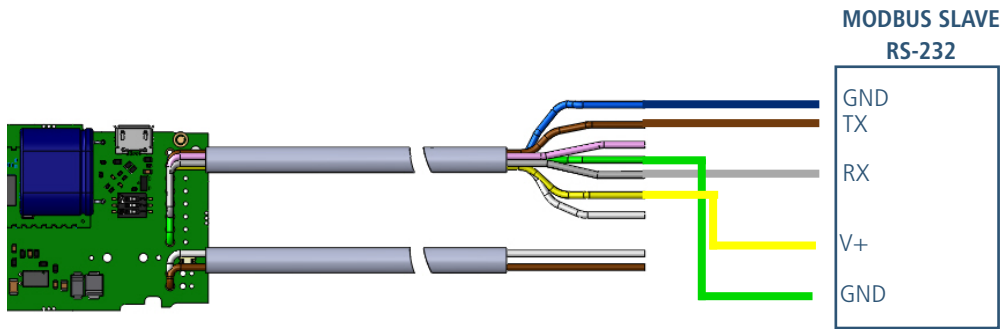
4.5. 2-wire RS485 example of wiring



Associated configuration:

- Register 321 : bit 0 = 0 (RS485)
- Switch :
 - Int 1 = ON (RS-485 bus end-of-line resistor)
 - Int 2 and 3 = ON (RS-485 bus polarization)

4.6. RS232 example of wiring



EN

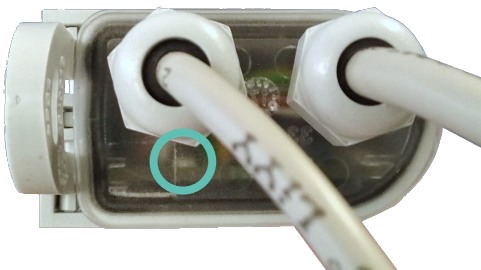
Associated configuration:

- Register 321 : bit 0 = 1 (RS232)
- Switch :
 - Int 1 = OFF (RS-485 bus end-of-line resistor)
 - Int 2 et 3 = OFF (RS-485 bus polarization)

4.7. LED an help to install

In order to help to install the MODBUS device with one or several Modbus slaves, the LEDs of the device can help the user.

After the wiring and starting-up of the device, this one will test the entire configuration (periodical and alarms) to verify that all the requests can be done between the MODBUS device and all the registers of the slave(s) configured.



- If no error is detected: a **green LED** will be ON during 10 seconds.
- If an error is detected: a **red LED** will be ON during 10 seconds.

5. DOCUMENT HISTORY

Version	Content
V1.0.0	Creation