User Guide - DELTA P - LoRaWAN EU863-870

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PRODUCTS AND REGULATORY INFORMATION

This document applies to the following products:

LoRaWAN DELTA P
Reference: ARF8283AA
Firmware version :

RTU: V2.0.1
APP: V2.0.1

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1. DEVICE OVERVIEW

Description :

- The adeunis LoRaWAN DELTA P is a ready-to-use radio transmitter that measures either a pressure delta between the inside of a ventilation box and atmospheric pressure or a pressure delta on either side of an element (e.g. filter).
- The product meets the needs of users who want to remotely monitor a ventilation system.
- The product sends data at preset intervals or when the high or low thresholds are exceeded.
- The user may access the transmitter configuration locally via a micro-USB port or remotely via the LoRaWAN network, allowing in particular the setting of the sampling, transmission modes or alarm thresholds.
- The product also contains 2 digital inputs/outputs for coupling with newer systems with dry contact outputs and 1 Analog input 0-10 V for coupling with a 0-10 V sensor (current clamp for example).
- The LoRaWAN DELTA P is powered by a replaceable internal battery pack.
- The product is compatible with adeunis's KARE+ service offer.

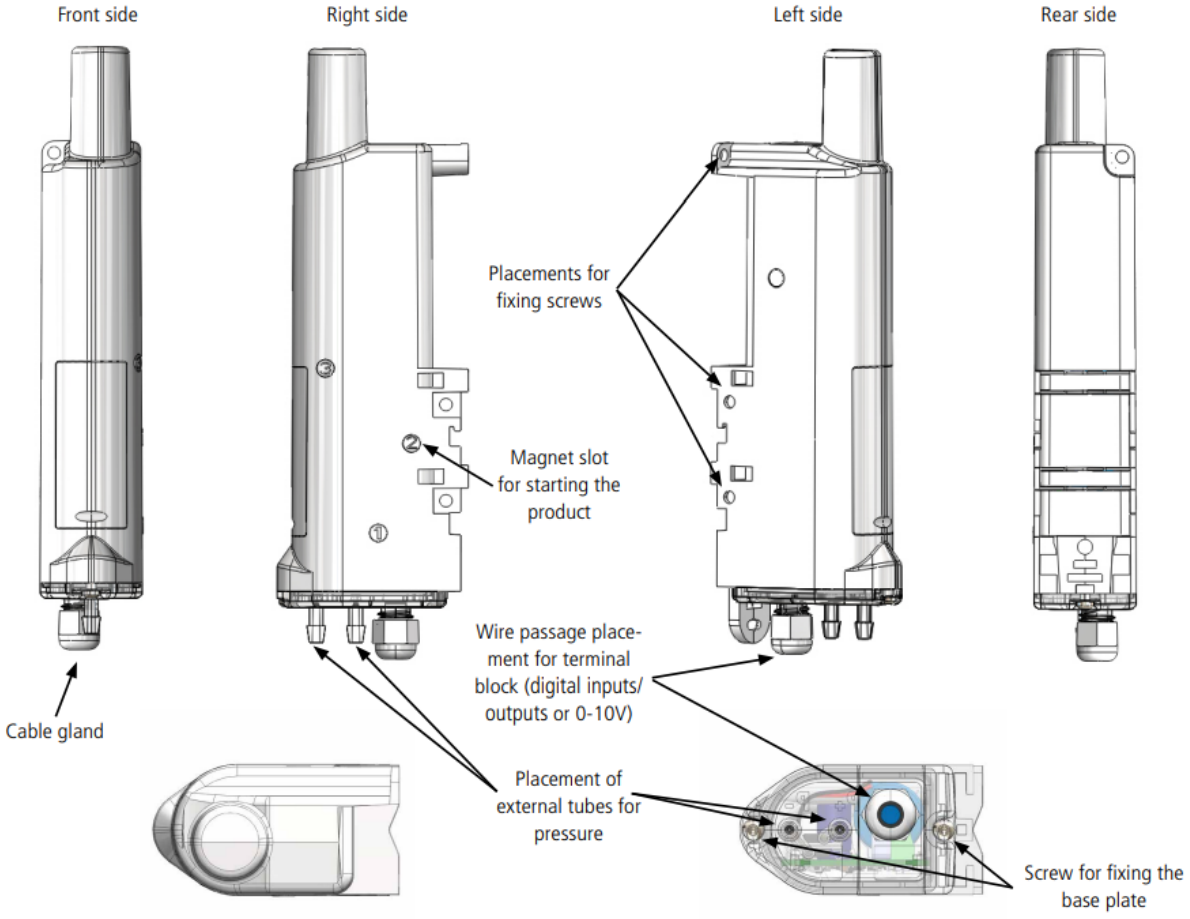
IMPORTANT NOTE 1:
The LoRaWAN DELTA P is delivered by default with an OTAA configuration, so the user can declare the device to a LoRaWAN operator

Package contents

The device is delivered in a carton package containing the following:

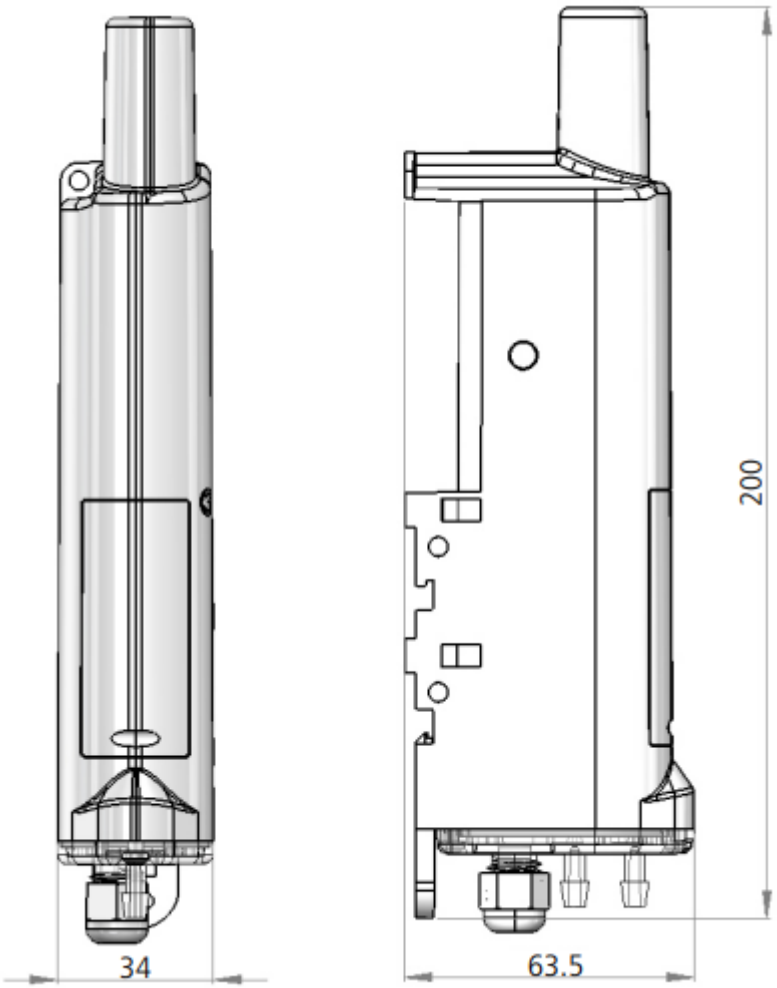
Front panel, rear panel and electronic board, Removable LiSOCl2 FANSO (battery-pack ER18505H+W36+51021) 2 x CBLZ 3.5x 19mm screws, 2 x SX5 Fischer plugs

1.1. General description

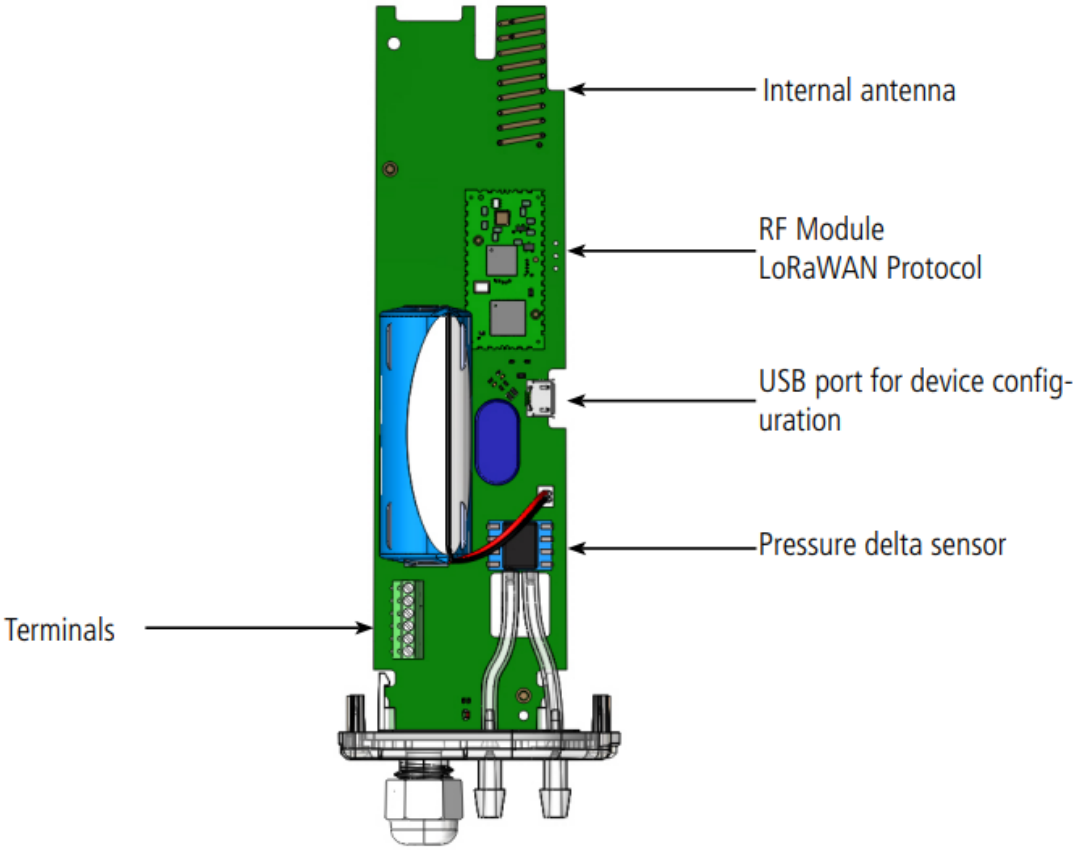


1.2. Dimensions

Values are in millimeters



1.3. Circuit board



1.4. Technical Specifications

1.4.1 General characteristics

Parameters	Value
Supply voltage	Nominal 3.6V
Power supply	Removable LiSOCl2 FANSO (battery-pack ER18505H+W36+51021)
Operating temperature	-20°C / +70°C
Dimensions	200 x 63.5 x 34 mm
Case	IP68
LoRaWAN Zone	EU 863-870 MHz
LoRaWAN Specification	1.0.2
Max transmit power	14 dBm

Parameters	Value
Application port (downlink)	1

1.4.2 Autonomy

Use Case	Autonomy SF7 (ans)	Autonomy SF12 (ans)
Number of shipments per day: 144 frames (72 for the Delta P and 72 for the 0-10V range)DELTA P sampling period: 1 minute Input sampling period 0-10 V: 1 minuteNumber of event on I/O 1: 86400 (theoretical max at 1 event per second)Number of event on I/O 2: 86400 (theoretical max at 1 event per second)	2.4	<1.0
Number of shipments per day: 144 frames DELTA P sampling period: 10 minutes Input sampling period 0-10 V: 30 minutes Number of event on I/O 1: 0 (disabled) Number of event on I/O 2: 0 (disabled)	> 10	1.2
Number of shipments per day: 2 frames DELTA P sampling period: 10 minutesInput sampling period 0-10 V: 0 (0-10V range disabled) Number of event on I/O 1: 0 (disabled)Number of event on I/O 2: 0 (disabled)	> 10	> 10
Number of shipments per day: 24 frames DELTA P sampling period: 10 minutesInput sampling period 0-10 V: 0 (0-10V range disabled) Number of event on I/O 1: 0 (disabled)Number of event on I/O 2: 0 (disabled)	> 10	5.4
Number of shipments per day: 48 periodic frames and 30 alarms DELTA P sampling period: 10 minutesInput sampling period 0-10 V: 10 minutes Number of event on I/O 1 events: 0 (disabled) Number of event on I/O 2 events: 0 (disabled)	12.5	2.0

The above values are estimates made under certain operating and environmental conditions (25°C and 1 year of storage). They do not represent any guarantee made by adeunis.

1.4.3 Environmental conditions and ingress protection

The casing of the LoRaWAN DELTA P IP68 has been tested to ensure a certain level of dust and water protection.

- For dust: level 6 guarantees complete sealing against
- For water: level 8 guarantees at least a complete waterproof casing for more than 1 hour in one meter deep.

The tests carried out by Adeunis for the immersion were under the following conditions: immersion for 10 hours at a depth of 1 meter in water at room temperature (around 20 ° C) followed by an immersion for one hour in water at 60 °C.

We can therefore guarantee the waterproofness of our IP68 case for immersions less than or equal to these times. Any use of our sensor outside the criteria mentioned above cannot be guaranteed by Adeunis.

Important: the degree of protection IP68 does not, in any way, guarantee protection against condensation linked to ambient humidity and temperature variations. Large variations in temperature and / or prolonged high relative humidity can lead to an early end of product life.

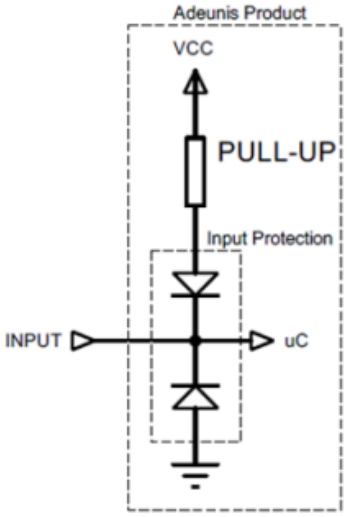
Depending on the mission profile of your product, we advise you to contact us.

1.4.4 Characteristics of the pressure delta sensor

Characteristics		Unit
Range	-500 / +500	Pa
Accuracy on the entire range	+/- 30	Pa
Resolution	1	Pa

1.4.5 Digital input interfaces

The principle diagram of the digital input interfaces is as follows :



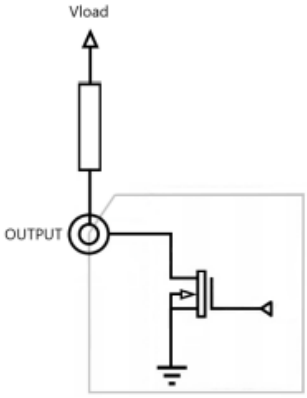
Maximum absolute values		Unit
Minimum input voltage	- 0,7	V
Maximum input voltage	+50	V

Electrical Characteristics		Unit
Minimum input voltage	0	V
Maximum input voltage	24	V
Current consumption input level HIGH	0	µA
Current consumption input level LOW	3.3	µA

Values above the absolute maximum values will damage the device.

1.4.6 Digital output interfaces

The principle diagram of the digital output interfaces is as follows :



Maximum absolute values		Unit
Minimum charging voltage	- 0,7	V
Maximum charging voltage	+50	V
Max voltage	150	mA

Electrical Characteristics		Unit
Minimum input voltage	0	V
Maximum input voltage	24	V
Output frequency	10	Hz
Current consumption output level HIGH	0	µA
Current consumption output level LOW	0.5	µA
Max voltage recommended	100	mA

Values above the absolute maximum values will damage the device.

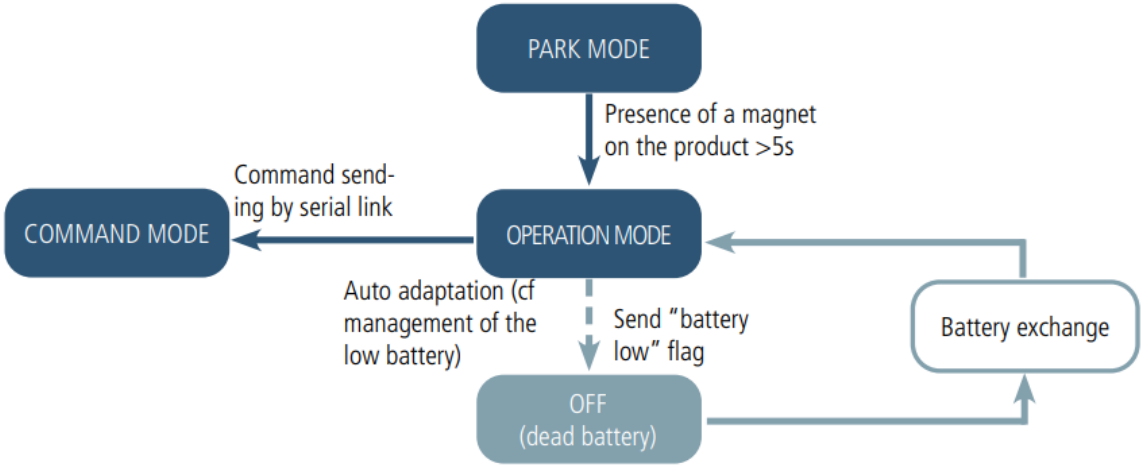
1.4.7 Characteristics of analog input 0-10 V

Electrical Characteristics		Unit
Range	0 - 10264 max : 15000	mV
Resolution	1	mV
Accuracy (<1000 mV)	+/- 1	% max
Accuracy (1000 - 10000 mV)	+/- 0.2	% max

2. DEVICE OPERATION

2.1. Operating modes

IMPORTANT NOTE: adeunis uses the Big-Endian data format
The device has several operating modes :



2.1.1 PARK MODE

The device is delivered in PARK mode, it is thus in standby mode and its consumption is minimal. Exit PARK mode by putting the magnet on the “2” mentioned on the product for more than 5 seconds. The green LED lights up to indicate the detection of the magnet and then flashes rapidly during the device start-up phase.
The device then sends its configuration and data frames.

2.1.2 COMMAND MODE

This mode is used to configure the device registers. There are two ways to enter this mode:

- Open the adeunis IoT Configurator application, connect a cable to the device’s micro-USB port and connect it to the computer or mobile
- Connect a cable to the micro-USB port of the device and enter command mode via an AT

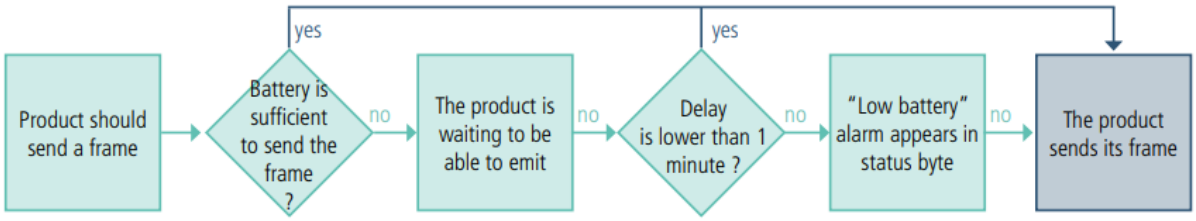
The output of the COMMAND mode is via the ATO command or the USB cable disconnection. The device will then return to its previous mode, i.e. PARK or OPERATING.

2.1.3 OPERATING MODE

This mode allows the device to work in its intended end use.This mode allows the device to work in its intended end use.

2.1.4 Management of the battery low

When the product detects that the battery is not anymore in capacity to deliver the energy needed to send a frame (extreme temperatures or end-of-life of the battery) it waits to be in capacity to transmit. If it detects that the delay generated is longer than 1 minute it informs the user via the “battery low” flag in the status byte of each frame.



The battery low alarm is switching off if the battery is replaced or when the temperature conditions are favorable for the proper functioning of the battery.

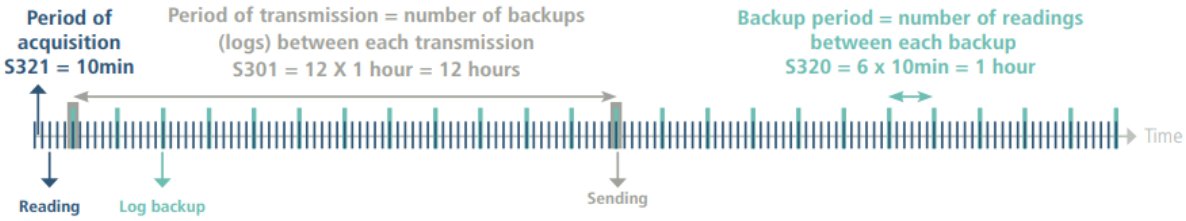
2.1.5 Three transmission modes to meet needs

The device can measure a delta pressure, save this information and send it in three transmission modes.

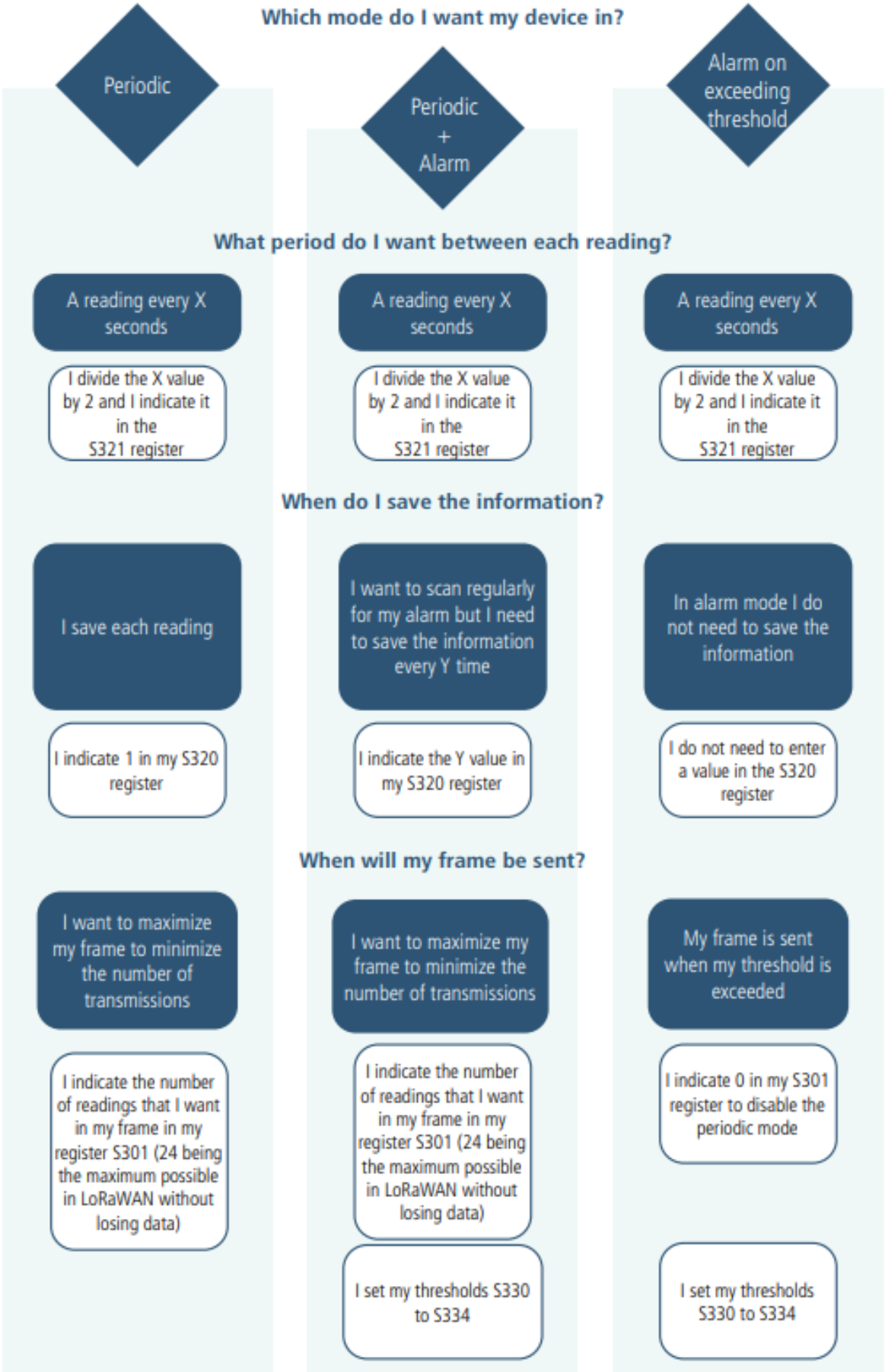
	Periodic transmission	Transmission over threshold	Periodic transmission and over threshold
Definition	Periodic transmission allows data to be collected in a specified period of time, to be saved and sent on a regular basis fo**r analysis over time.**	The transmission of a frame over threshold makes it possible to read data according to a given period and to send **an alarm only if one of the thresh- olds is exceeded.**	**Mix of the two modes** in order to be able to read regularly to receive alerts if the threshold is exceeded and to save the information regularly to make the analysis over time.

	Periodic transmission	Transmission over threshold	Periodic transmission and over threshold
Specific user situation	I want to take a reading of my pressure delta every half hour. I want to minimize my number of uplink to optimize my autonomy, so I want to put as many readings as possible in each data frame without losing any data.	I want the product to alert me if my pressure delta falls below 100 Pa.	I want to know the pressure delta of my HVAC during the day and be alerted if the pressure delta falls below 100 Pa. My product will send me an hourly reading of the pressure delta twice per day and trigger an alarm if my pressure delta falls below 100 Pa.
Related configuration	• **Acquisition period** (S321) = 900 (900s x2 = 1800 seconds or 30 minutes) • **Number of acquisitions before backup** (S320) = 1 (1backup at each reading) • **Number of backup before transmission** (S301) = 24 (24 backups per frame) • Pressure Delta alarm (S330) = 0 (alarm off) • Input alarm 0-10 V (S350) = 0 (alarm off)	• **Acquisition period** (S321) = 300 (300s x2 =10 minutes) • **Number of backups before transmission** (S301) = 0 (no sending at intervals) • Type of delta pressure alarm (S330) = 1 (low threshold) • Lower threshold (333) = 100 (in Pa) • Low threshold hysteresis (S334) = 10 (in Pa) the alarm is triggered only when pressure delta exceeds 110 Pa.	• **Acquisition period** (S321) = 300 (300s x2 =10 minutes) • **Number of acquisitions before backup** (S320) = 6 (6 x 10 min = 1h) • **Number of backups before transmission** (S301) = 12 (12 X 1h = 12h) • Type of delta pressure alarm (S330) = 1 (low threshold) • Lower threshold (333) = 100 (in Pa) • Low threshold hysteresis (S334) = 10 (in Pa) the alarm is trig- gered only when pressure delta exceeds 110 Pa.
In the use	Paragraph 2.1.5.01	Paragraph 2.1.5.02	See schema below

CAUTION: The ability to transmit information will depend on the network used. Here, the mentioned cases works with LoRaWAN technology. The complete list of registers can be found in section 3.4.



Procedure to follow to program its registers according to the chosen mode.

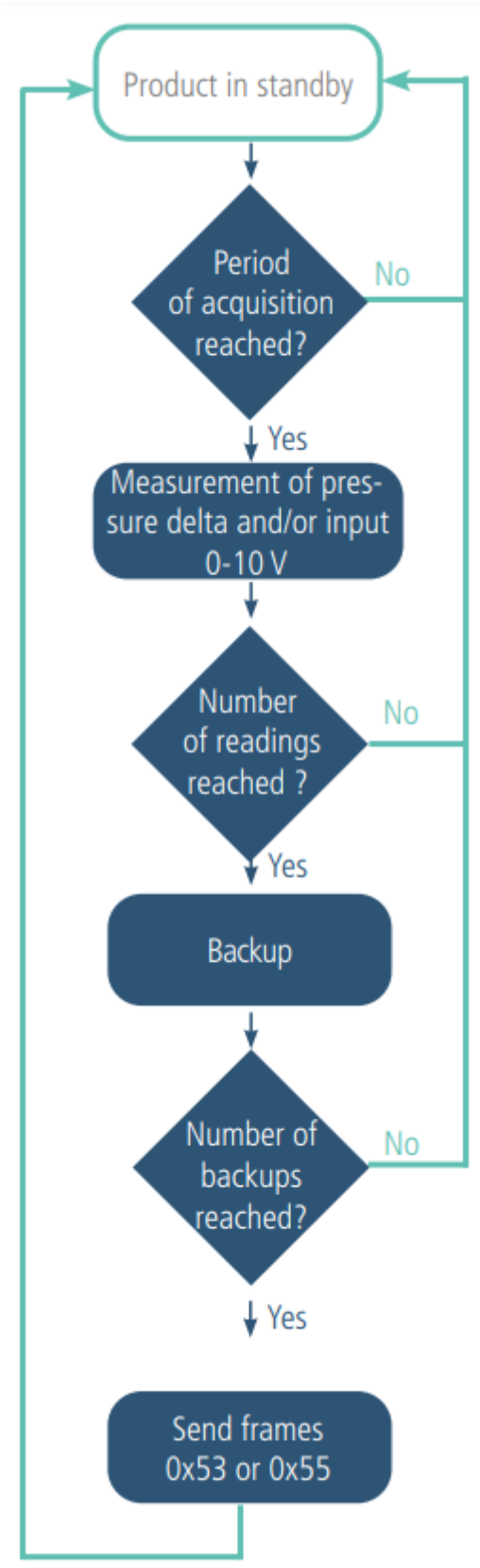

Which mode do I want my device in?
Periodic
Periodic + Alarm
Alarm on exceeding threshold
What period do I want between each reading?
A reading every X seconds
I divide the X value by 2 and I indicate it in the S321 register
A reading every X seconds
I divide the X value by 2 and I indicate it in the S321 register
A reading every X seconds
I divide the X value by 2 and I indicate it in the S321 register
When do I save the information?
I save each reading
I indicate 1 in my S320 register
I want to scan regularly for my alarm but I need to save the information every Y time
I indicate the Y value in my S320 register
In alarm mode I do not need to save the information
I do not need to enter a value in the S320 register
When will my frame be sent?
I want to maximize my frame to minimize the number of transmissions
I indicate the number of readings that I want in my frame in my register S301 (24 being the maximum possible in LoRaWAN without losing data)
I want to maximize my frame to minimize the number of transmissions
I indicate the number of readings that I want in my frame in my register S301 (24 being the maximum possible in LoRaWAN without losing data)
I set my thresholds S330 to S334
My frame is sent when my threshold is exceeded
I indicate 0 in my S301 register to disable the periodic mode
I set my thresholds S330 to S334

Example of possible configurations:

Desired case (except 100% event)	Associated configuration	Theoretical number of periodic frames sent per day
• Read/Sampling: 10 minutes • Backup: every hour (every 6 readings) • Sending: every half day (every 12 backups)	• 321 = 300 • 320 = 6 • 301 = 12	2 frames
• Read/Sampling: 10 minutes • Backup: at each reading • Sending: maximum tolerated by my frame (here, LoRaWAN)	• 321 = 300 • 320 = 1 • 301 = 24	6 frames
• Read/Sampling: 5 minutes • Backup: every 15 minutes (every 3 readings) • Sending: every hour (i.e., every 4 backups)	• 321 = 150 • 320 = 3 • 301 = 4	24 frames
• Read/Sampling: every hour • Backup: at each reading • Sending: at each backup	• 321 = 1800 • 320 = 1 • 301 = 1	24 frames
• Read/Sampling: every hour • Backup: at each reading • Sending: every 4 hours (every 4 backups)	• 321 = 1800 • 320 = 1 • 301 = 4	6 frames
• Read/Sampling: every 10 seconds • Backup: every minute (every 6 readings) • Sending: every quarter hour (every 15 backups)	• 321 = 5 • 320 = 6 • 301 = 15	96 frames
• Read/Sampling: every hour • Backup: at each reading • Sending: every 10 minutes (every 10 backups)	• 321 = 30 • 320 = 1 • 301 = 10	144 frames

2.1.5.01 Periodic sending with or without backup

The product allows the measurement and periodic transmission of the values of the pressure delta sensor and/or the analog input according to the following diagram:



The main parameters associated with this operating mode for the pressure delta are:

- Period of acquisition (S321)

- Backup period (S320)
- Period of transmission(S301)

The main parameters associated with this operating mode for the analog input are:

- Period of acquisition (S323)
- Backup period (S322)
- Period of transmission(S324)

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

Example :

Register	Value encod- ing	Value	Result
S321	Decimal	5400	1 reading every 3 hours 5400*2sec = 10800 sec = 3h
S320	Decimal	1	1 backup for each reading
S301	Decimal	8	1 sending every 8 backups (8*3h) = every 24 hours
S323	Decimal	0	Disabling the periodic mode and alarm for the analog input
S330	Decimal	0	Delta pressure alarm deactivated
S350	Decimal	0	Alarm Analog input disabled
S380	Hexadecimal	0x00	Disabled digital input 1 alarm
S380	Hexadecimal	0x00	Disabled digital input 2 alarm

In this example:

- The product reads the pressure delta every 3 hours and saves the
- No information reading on the analog
- The product will perform 8 backups and transmit them once a
- The product is in pure periodic emission since the alarms are

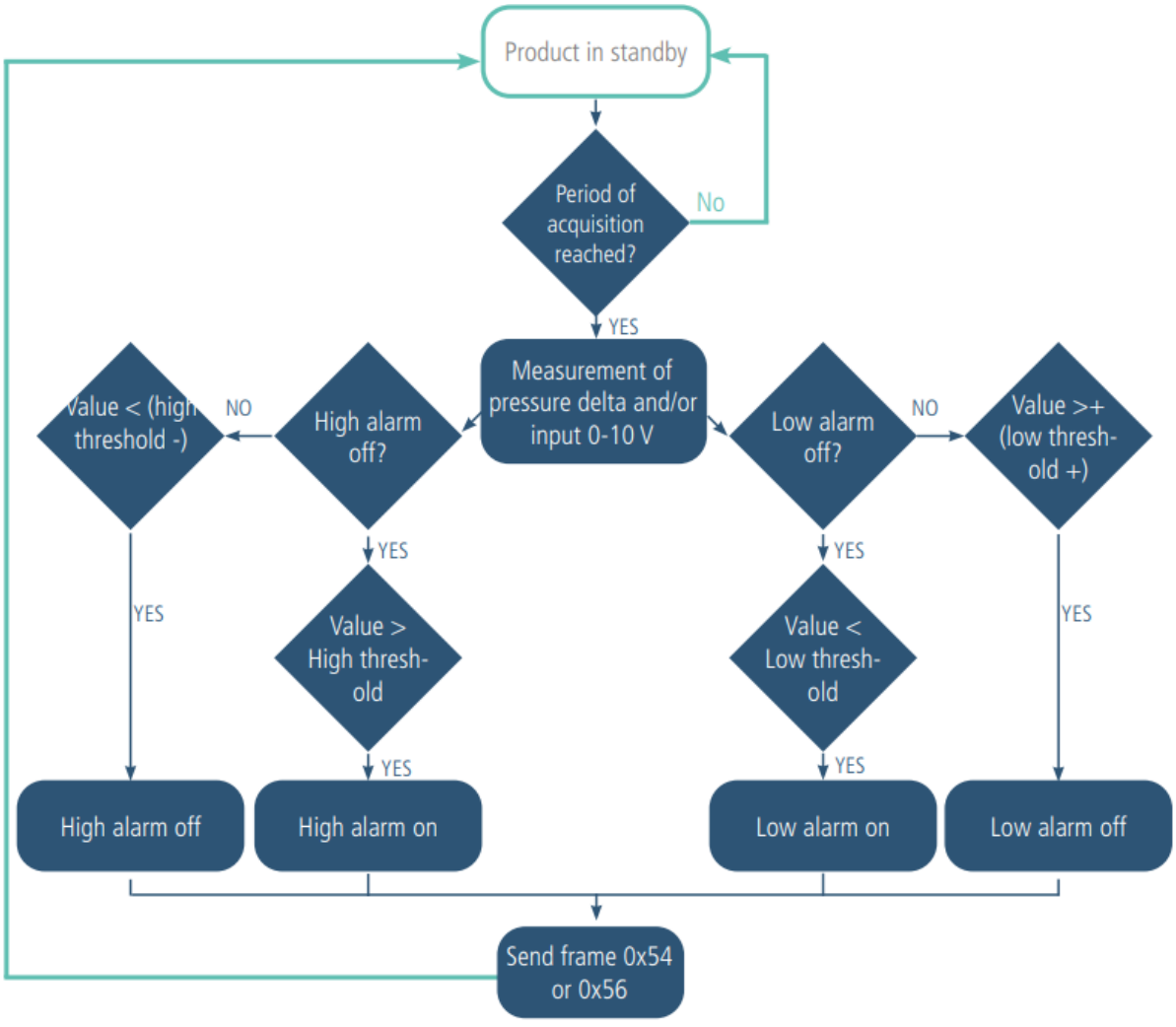
ADVICE FROM ADEUNIS : By default the product is set to read the pressure delta every hour (S321 = 1800). For pure periodic transmission, it is recommended to configure the acquisition period at the desired backup frequency in order to gain considerably in autonomy (here 5400 corresponding to 3 hours).

Be careful about backup and sending values that will also depend on the network used and its bandwidth.

Note: for a transmission without history, it is sufficient to set register 301 for the pressure delta or register 324 for the analog input 0-10V (transmission period) to 1 so the product will send a frame to each backup.*

2.1.5.02 Transmission on exceeding the threshold

The product allows the detection of threshold overruns (high and low) for the pressure delta and for the 0-10 V analog input according to the following diagram. The product sends a data frame when the threshold is exceeded but also when the situation returns to normal.



Example :

Register	Value encoding	Value	Result
S301	Decimal	0	Event mode (no periodicity)

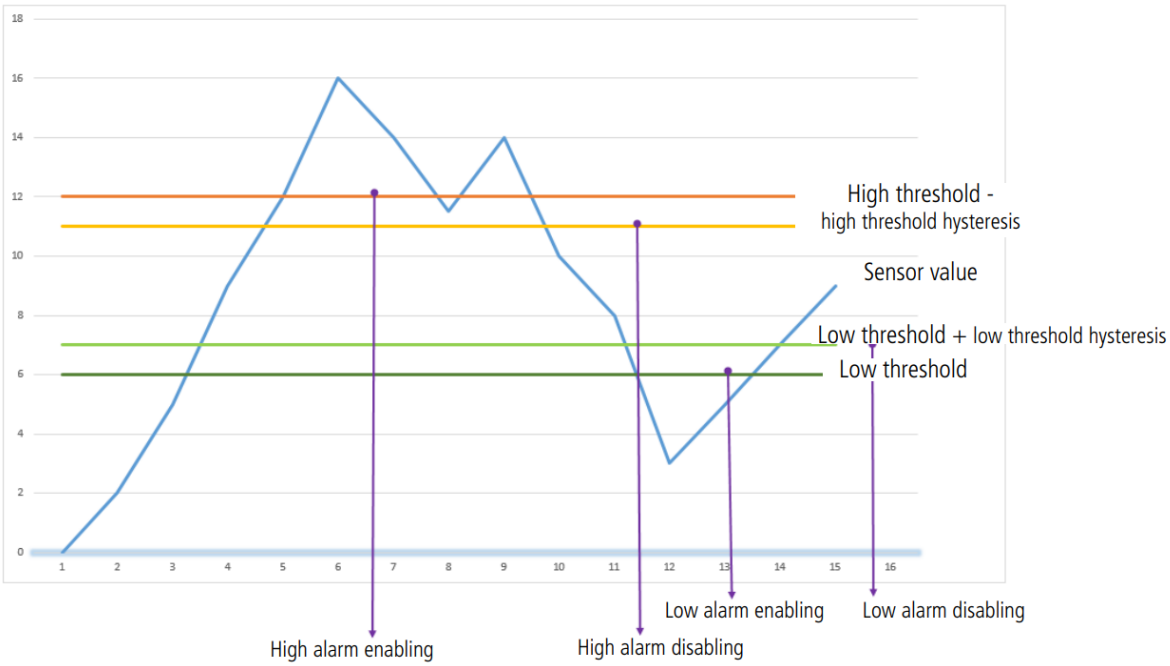
Register	Value encoding	Value	Result
S321	Decimal	300	One reading every 10 minutes (300/60 sec x 2)
S340	Decimal	1	Alarm type for low threshold
S343	Decimal	200	Pressure delta at 200 Pa
S344	Decimal	10	Hysteresis at 10 Pa above the low threshold or 210 Pa

In this example:

- The device reads the pressure delta every 10 minutes
- The product will trigger an alarm if the pressure delta is below 200 Pa
- The alarm will be deactivated if the pressure delta rises above 210 Pa

NOTE: As described in 2.1.5 it is possible to combine the periodic mode and the alarm mode.

Explanation of thresholds and hysteresis:



The parameters associated with this operating mode are:

- The transmission period (equal to zero in this case of use) (S301 or S324)
- The acquisition period (S321 or S323).

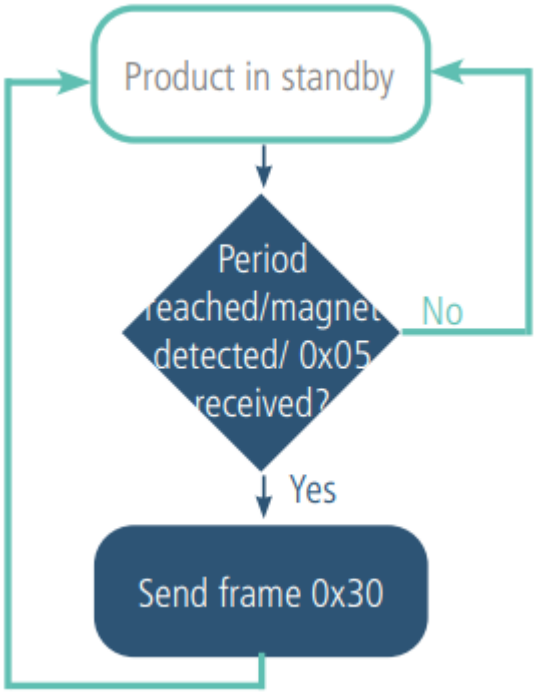
- The type of alarm for the pressure delta (S330) or the 0-10 V analog input (S350).
- The high alarm threshold for the pressure delta (S331) or the 0-10 V analog input (S351).
- The high alarm hysteresis for the pressure delta (S332) and the analog input 0-10 V (S352).
- The low alarm threshold for the pressure delta (S333) or the 0-10 V analog input (S353).
- The low alarm hysteresis for the pressure delta (S334) or the 0-10 V analog input (S354).

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

2.1.6 Transmitting the Keep Alive frame

If the device does not have periodic data configured, and no threshold is exceeded, it may not transmit data for a long time. So, to be sure that the device is working properly, it transmits a Keep Alive frame (0x30) according to a determined frequency (S300). It is also possible to send this frame to know instantaneously the delta pressure, the value on the 0-10 V analog input or to know the state of the 2 digital inputs, putting a magnet during 3 seconds on the “2” of the case or sending a 0x05 downlink frame.

The parameters associated with this operating mode is the setting of the transmission period of the Keep Alive frame (register 300).

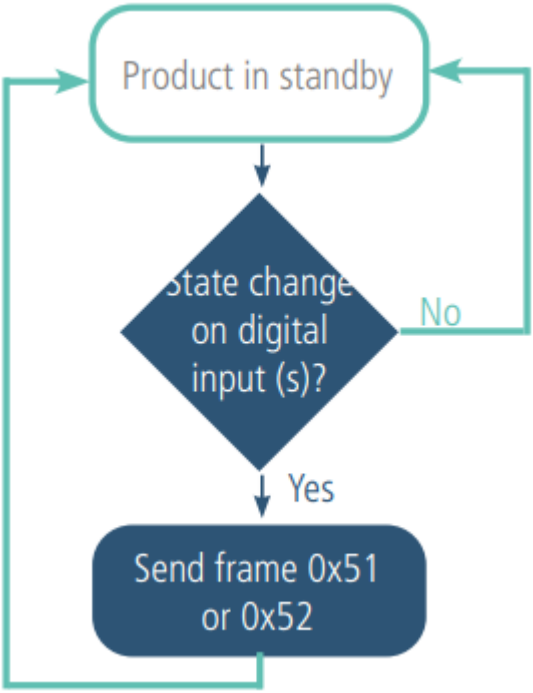


E.g.: I want a Keep Alive frame sent to me every 24 hours

Register	Value encoding	Value	Result
S301	Decimal	0	Disabling periodic sending
S300	Decimal	8640	8640x10 = 86 400 seconds or 1440 minutes or 24 hours

2.1.7 Digital Input alarm(s)

The device incorporate two digital inputs/outputs via a terminal block, allowing to detect a change a change in up and down state.
The device allows the sending of a frame following a change of state on one of its inputs according to the following diagram:



Example :

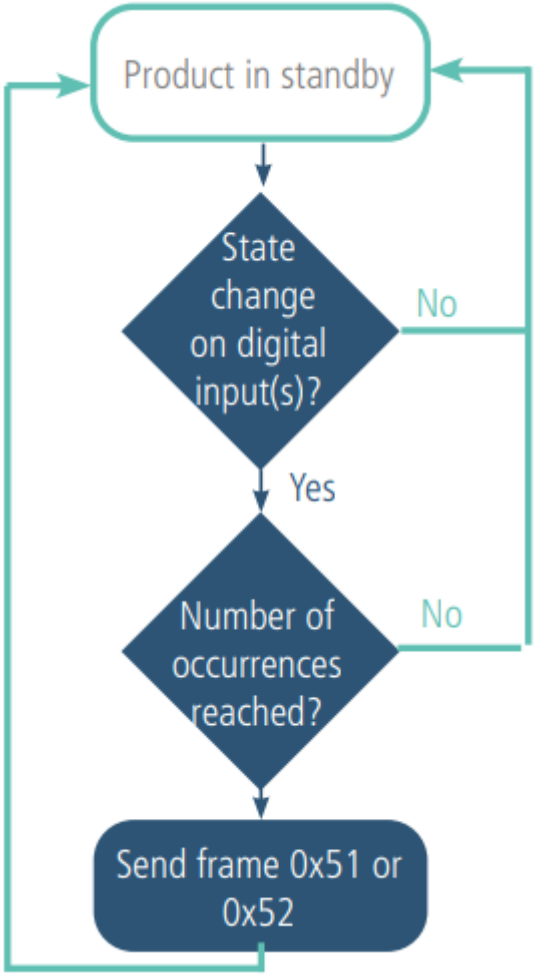
Register	Value encoding	Value	Result
S380	Hexadecimal	0x41	Configuration of the Digital Input/Output 1: • Detection of declining fronts • Debounce time* 100ms
S381	Decimal	1	The device sends a frame every event detect on digital input/output 1
S382	Hexadecimal	0x0	Configuration of the Digital Input/Output 2: • Disabled • No debounce time

*Debounce time: minimum time to take account of a change of state. For example, if this period is 10 ms all pulses (high or low level) whose duration is less than 10 ms will not be considered. This technique avoids potential rebounds during a change of state.

In this example the device:

- The device has a debounce time of 100ms and the digital input 1 alarm is enabled (register 382).
- The device sends a frame for each detection of an event (register 381)
- The alarm via the terminal block is disabled (register 382)

NOTE: It is possible to program the sending of a frame only after a certain number of edge detections (S381/S383).



Example :

Register	Value code	Value	Result
S382	Hexadecimal	0x41	Configuration of the Digital Input/Output 2: • Detection of high edges • Debounce time* 100ms
S383	Decimal	5	The device sends a frame after detection of 5 declining fronts (event ON)

*Debounce time: minimum time to take account of a change of state. For example, if this period is 10 ms all pulses (high or low level) whose duration is less than 10 ms will not be considered. This technique avoids potential rebounds during a change of state.

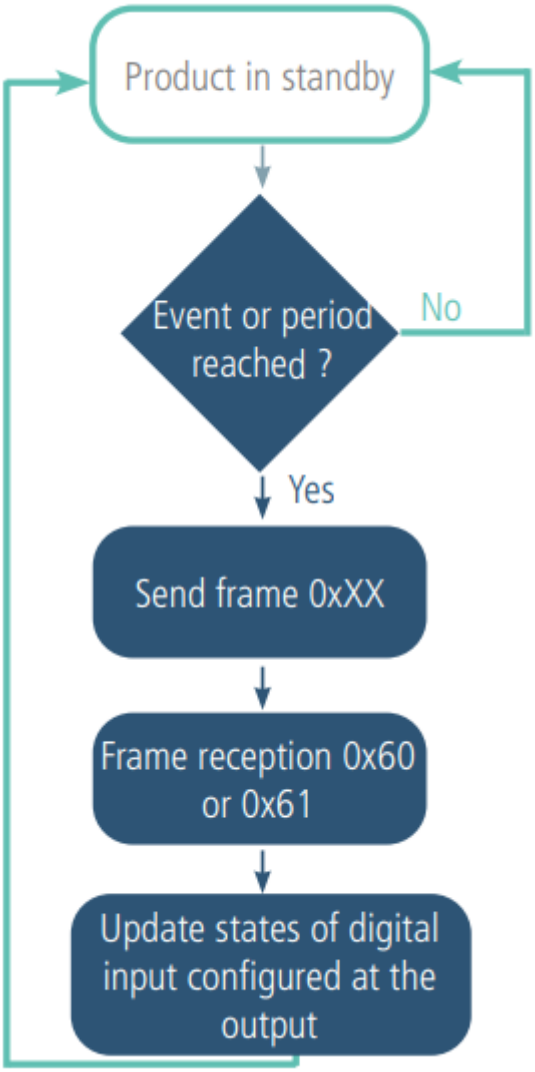
In this example the device:

- The device has a debounce time of 100 ms and an alarm is enabled on the digital input 2 (register 383).
- The device sends a frame as soon as it has detected 5 high edges on its digital input per terminal block (register S382)

The digital inputs operate only in event mode (no periodic sending).

2.1.8 Product output control(s)

The product allows configuring all or part of the digital outputs in order to control them from the network by a downlink frame as shown in the following diagram :



The parameters associated with this operating mode are:

• The configurations of the different digital inputs/outputs (registers 380 and 382)

The complete list of registers may be found in section 3.4.

Example :

Register	Value coding	Value	Result value
S380	Hexadecimal	0x73	Configuration of the digital input/output 1: • Periodic mode • Counting of high and low fronts • 1 second guard period
S382	Hexadecimal	0x05	Configuration of the digital input/output 2: • Output (default state= 1/CLOSE) • No on-call period

In this example, I/O 2 is configured as an output with a default state of 1.

2.2. Operation of the LEDs

Mode	Red LED State	Green LED State
Product in Park mode	Off	Off
Magnet detection process (1 to 6 seconds)	Off	ON as soon as the magnet is detected for up to 1 second
Starting the product (after detection of the magnet)	Off	Fast flashing 6 cycles 100 ms ON/ 100 ms OFF
JOIN process	During the JOIN phase: flashing: 50 ms ON / 1s OFF If JOIN phase completed (JOIN ACCEPT) : flashing: 50 ms ON / 50 ms OFF (x6)	During the JOIN phase: flashing: 50 ms ON / 1s OFF (just after red LED) If JOIN phase completed (JOIN ACCEPT): flashing: 50 ms ON / 50 ms OFF (x6) (just before red LED)
Switching to command mode	Fixed on	Fixed on
Low battery power level	Flashing (0.5 s ON every 60s)	-

Mode	Red LED State	Green LED State
Defective product (factory return)	Fixed on	-
Detection of the magnet in operating mode	Off	Flashing 50ms ON / 50ms OFF as soon as the magnet is detected for up to 3 seconds

3. REGISTERS AND FRAME DESCRIPTION

To know the content of the registers and of each frames (uplink and downlink) of the product, refers to the TECHNICAL REFERENCE MANUAL of the DELTA P, available on the adeunis website: https://www.adeunis.com/en/produit/delta-p-2/

4. CONFIGURATION AND INSTALLATION

4.1. Configuration and installation of the transmitter

To configure the product, it is recommended to use the IoT Configurator (android and Windows application).

- Google Play : https://play.google.com/store/apps/details?id=com.adeunis.IoTConfiguratorApp
- Windows 10: https://www.com/telechargements/

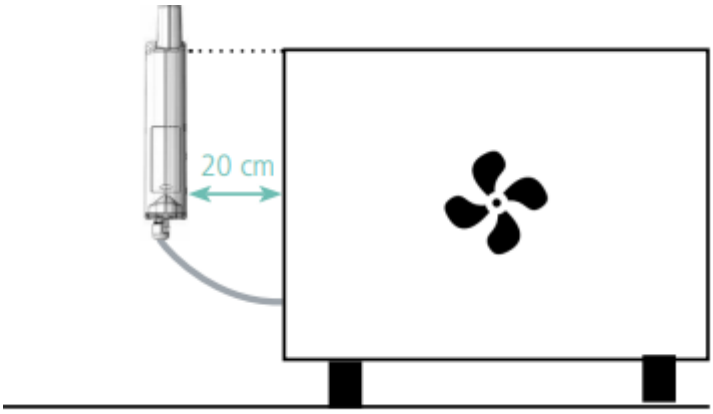
To configure the product using AT Command or install the product, please refers to the INSTALLATION GUIDE adeunis available on the website. The product can be also configured via the network sending downlinks. To do it, refer to the TECHNICAL REFERENCE MANUAL of the DELTA P, available on the adeunis website: https://www.adeunis.com/en/produit/delta-p-2/

4.2. Installation on a ventilation system

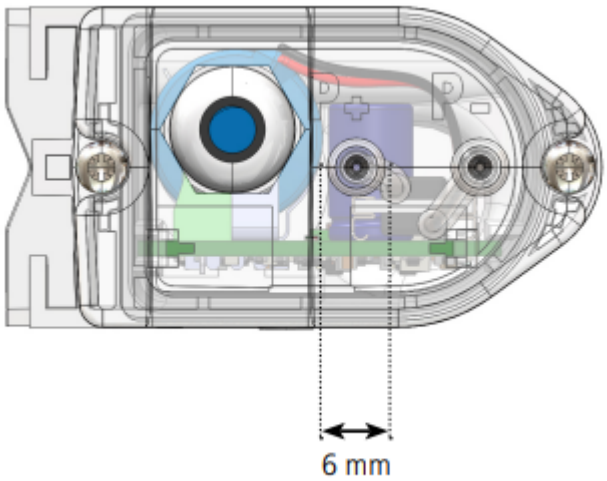
Since Air Handling Unit (AHU) are usually in enclosed areas or on roofs (Rooftop package unit), certain installation rules must be followed to ensure proper operation of the product:

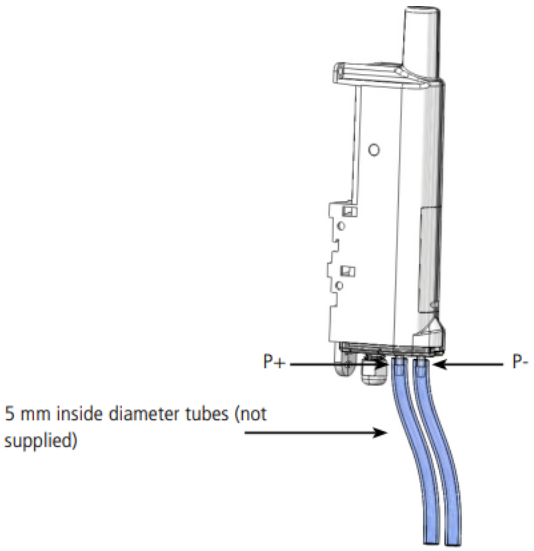
- Do not position the product in a location where it will be subject to temperatures outside the product's operating temperature range.
- Do not position the product directly next to the ventilation system (about 20 cm laterally or the antenna above the box) as these are mainly made of metal, which may greatly reduce the range of radio waves and therefore the transmission and reception quality of the product.
- Avoid the use of tubes longer than 2 meters as this may impact the measurements made (longer pressure times).
- Position the product higher than the box to be monitored so that the cables are always below the product and thus prevent any condensa- tion (due to humidity) from entering the product and damaging it.
- Take care when installing the tubes so that they are not pinched or pierced as this will impact the measurements made.

4.3. Connecting the outer tubes



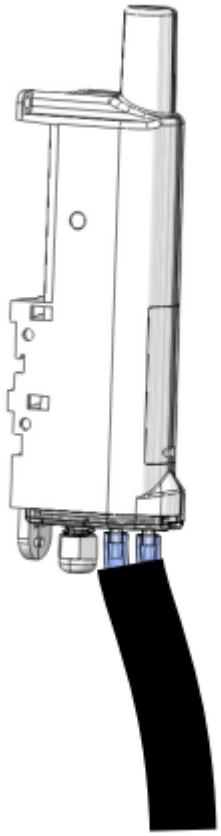
In order to ensure optimal operation of the product it is necessary to connect it correctly. The outer tubes are not supplied with the product. Find below the ribs to be able to choose suitable tubes:





In order to ensure proper connection of the product, take care to connect the tube positioned where the pressure is highest on the P+ support (indicated on the base plate) and to connect the tube going into the section with the lowest pressure on the P- support.

In order to avoid premature degradation of tubes exposed to the sun, Adeunis



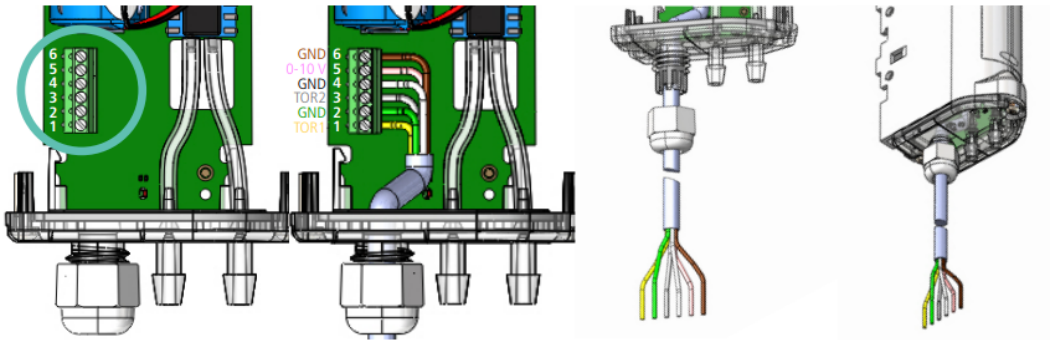
strongly recommends covering the tubes with an anti-UV sheath.

4.4. Cabling Digital inputs/outputs 2 via the terminal block

In order to be able to couple a 0 -10 V sensor or dry contact sensors with the product, connect the sensor to the board terminal block.

Connecting the wires:

1. Open the case (paragraph 1)
2. Connect the wires as shown in the diagram below
3. Configure the registers associated with the connected sensors (paragraph 3)
4. Close the case
5. Restart the product with the magnet as for the initial start-up.



After this procedure, product will react as if it were the initial start-up

Examples :

LoRaWAN DELTA P may easily be coupled with a newer ventilation system with dry contact outputs. It may also be coupled with a current clamp to monitor the voltage in the power cable of the ventilation system on which it is positioned and thus more readily detect a power failure.

DOCUMENT HISTORY

Version	Content
V1.0.0	Creation
V2.0.0	Minor modifications + new APP ans RTU firmwares
V2.0.1	More information about the battery