PULSE V4

Technical Reference Manual

LoRaWAN / Sigfox / NB-IoT

Applicable for APP versions >= 2.1.0

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NEW DOCUMENTATION / NOUVELLE DOCUMENTATION

	ENGLISH	FRANCAIS
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	• Dédié à un produit • Recommandations et avertissements électriques • Déclaration de conformité • Fonctionnalités et modes du produit • Dimensions du boitier • Caractéristiques (boitier et électrique) • Explication des LED • Câblage sur bornier spécifique au produit
TECHNICAL REFERENCE MANUAL	• Dedicated to a product • Registers content • Frame explanations (uplink and downlink)	• Dédié à un produit • Contenu des registres • Explication des trames (uplink et 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	• Pour tous les produits adeunis® • Configuration des produits • Installation et fixation • Démarrage des produits • Ouvrir et fermer les boîtiers • Remplacer la batterie

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1. REGISTERS

1.1 Generic registers

Register	Size (bytes)	Base	Description	Default Value	Range (Min-Max)	Comments
304	2	10	PIN code	0 (deactivated)	0 - 9999	PIN code used with ATPIN command. Value 0 disables the PIN code.
306	1	10	Product mode	0	0: PARK 1: PRODUCTION	In PARK mode, product is not using Radio. In PRODUCTION mode, product will send/receive RF uplinks/downlinks.
308	4	16	LED activity	0x0000007F	0 … 0xFFFFFFFF	Default: 7F Eco: 70 Other values: reserved

1.2 Applicative registers

Register	Size (bytes)	Base	Description	Default value	Min-Max Value	Comments
301	2	10	Transmit period of data	1	0 ... 65535	Number of backups (history logs) to be done before sending a frame (thus defining the sending period). The value 0 is equivalent to disabling the periodic mode.
315	1	10	Time zone offset	1	-12 … 14	Defines the Time Zone offset from UTC (in hours). Must be defined for Daylight Saving Time management.
316	1	10	Daylight Saving Time management	1	0 … 1	Only applicable for European countries. 0 : disabled 1 : enabled
318	1	10	Time stamping	1	0 … 1	LoRaWAN EU868 or NB-IoT only If enabled, adds a time stamp in data frames. 0 : disabled 1 : enabled
319	1	10	RTC calibration value	1	-100 … 100	Allows correcting a possible drift of the clock. In tenths of a second per day.

320	1	16	Channels configuration	0x11 (chA ON, chB ON)	0 … 0xFF	For channel A: • Bit 0: channel A activation • Value 0: channel deactivated • Value 1: channel activated • Bit 1: meter type channel A (pull-up activation) • Value 0: meter other than Gas (pull-up deactivated) • Value 1: Gas meter (pull-up activated) • Bit 2: Reserved • Bit 3: tamper input channel A • Value 0: deactivated • Value 1: activated For channel B: • Bit 4: channel B activation • Value 0: channel deactivated • Value 1: channel activated • Bit 5: meter type channel B (pull-up activation) • Value 0: meter other than Gas (pull-up deactivated) • Value 1: Gas meter (pull-up activated) • Bit 6: Reserved • Bit 7: tamper input channel B • Value 0: deactivated • Value 1: activated
321	2	10	History period	43200 (24h)	1 … 65535	x 2 seconds
322	2	16	Anti-bounce filter period (pulse minimum width) (channels A and B)	0x22	0 ... FF	Bits 0 to 3: debounce period - channel A • Value 0: deactivated • Value 1: 1 ms • Value 2: 10 ms • Value 3: 20 ms • Value 4: 50 ms • Value 5: 100 ms • Value 6: 200 ms • Value 7: 500 ms • Value 8: 1 s • Value 9: 2 s • Value A: 5 s • Value B: 10 s • Value C à F: reserved Bits 4 to 7: debounce period - channel B • Value 0: deactivated • Value 1: 1 ms • Value 2: 10 ms • Value 3: 20 ms • Value 4: 50 ms • Value 5: 100 ms • Value 6: 200 ms • Value 7: 500 ms • Value 8: 1 s • Value 9: 2 s • Value A: 5 s • Value B: 10 s • Value C à F: reserved

323	4	10	Current index value - channel A	0	0 ... 4294967295	Unit: number of pulses In COMMAND mode, it is possible to write a new value in this register (for example an initialization value, an adjustment value ...). Warning: this register does not contain current counter.
324	4	10	Current index value - channel B	0	0 ... 4294967295	
325	2	10	Flow calculation period (channels A and B)	60	1…. 1440	x 1 minute
326	2	10	Flow threshold (channel A)	0	0 ... 65535	Unit: pulses per hour 0: deactivated
327	2	10	Flow threshold (channel B)	0	0 ... 65535	Unit: pulses per hour 0: deactivated
328	2	10	Leak threshold (channel A)	0	0 ... 65535	Unit: pulses per hour 0: deactivated
329	2	10	Leak threshold (channel B)	0	0 ... 65535	Unit: pulses per hour 0: deactivated
330	2	10	Number of daily periods under the leak threshold (channel A)	0	0… 1440	0: deactivated The multiplication of this register by the period of flow measurement must be less than 24 hours otherwise the product will be perpetually in alarm.
331	2	10	Number of daily periods under the leak threshold (channel B)	0	0… 1440	0: deactivated The multiplication of this register by the period of flow measurement must be less than 24 hours otherwise the product will be perpetually in alarm.
332	1	10	Scan period for Channel A tamper input	2	1… 255	x10 seconds
333	1	10	Tamper detection threshold channel A	3	1… 255	Number of positive scans of A-channel tamper before triggering the tamper alarm
334	1	10	Scan period for Channel B tamper input	2	1… 255	x10 seconds
335	1	10	Tamper detection threshold channel B	3	1… 255	Number of positive scans of B-channel tamper before triggering the tamper alarm
340	1	10	Number of redundant samples per frame	0	0… 255	

1.3 Radio registers

1.3.1 LoRaWAN Network Registers

Register	Description	Encoding	Details
201	Spreading Factor (SF) by default	Decimal	Default: 12 (EU) / 10(US915/AS923) READ ONLY
204	Reserved	Hexadecimal	Do not use
214	LORA APP-EUI (first part – MSB)	Hexadecimal	Default: 0 Key encoded on 16 characters. Each register contains a part of the key. Used during the JOIN phase in OTAA mode E.g.: APP-EUI = 0018B244 41524632 • S214 = 0018B244 • S215 = 41524632
215	LORA APP-EUI (second part – MSB)	Hexadecimal	
216	LORA APP-KEY (first part – MSB)	Hexadecimal	Default: 0 Key encoded on 32-byte characters. Each of the 4 registers contains 8 characters. Used during the JOIN phase in OTAA mode E.g.: APP-KEY = 0018B244 41524632 0018B200 00000912 • S216 = 0018B244 • S217= 41524632 • S218=0018B200 • S219= 00000912
217	LORA APP-KEY (second part – MID MSB)	Hexadecimal	
218	LORA APP-KEY (third part – MID LSB)	Hexadecimal	
219	LORA APP-KEY (fourth part – LSB)	Hexadecimal	
220	LoRaWAN Options	Hexadecimal	Default: 5 (EU), 1(US915/AS923) Bit 0: Activation of the ADR ON (1)/OFF (0) Bit 1: Reserved Bit 2: DUTYCYCLE ON (1)/DUTYCYCLE OFF (0) Bits 3 & 4: Reserved Bits 5 to 7: Reserved CAUTION: Deactivation of the Duty Cycle may result in a violation of the conditions of use of the frequency band, depending on the use of the device, thus violating the regulations in force. In the case of disabling the Duty Cycle, liability is transferred to the user.
221	Mode of activation	Decimal	Default: 1 Choice: (see NOTE 1 after the table) • 0: ABP • 1: OTAA
222	LORA NWK_SKEY (first part – MSB)	Hexadecimal	Default: 0 Parameter encoded on 16 bytes. Each of the 4 registers contains 4 bytes.
223	LORA NWK_SKEY (second part - MID MSB)	Hexadecimal	
224	LORA NWK_SKEY (third part - MID LSB)	Hexadecimal	
225	LORA NWK_SKEY (fourth part – LSB)	Hexadecimal	
226	LORA APP_SKEY (first part – MSB)	Hexadecimal	Default: 0 Parameter encoded on 16 bytes. Each of the 4 registers contains 4 bytes.

Register	Description	Encoding	Details
227	LORA APP_SKEY (second part - MID MSB)	Hexadecimal	
228	LORA APP_SKEY (third part - MID LSB)	Hexadecimal	
229	LORA APP_SKEY (fourth part – LSB)	Hexadecimal	
258	Reserved	Decimal	Do not use
259	Band number (US915 only)	Decimal	Default: 0 0: the device uses all the channels [0-63] in 125 kHz and [64-71] in 500 kHz 1: the device will use just the Band n°1. Use the channels [0-7] in 125 kHz and a channel [65] in 500 kHz. … 8: the device will use just the Band n°8. Use the channels [56-63] in 125 kHz and 71 in 500 kHz.
260	Reserved	Decimal	Do not use
261	Reserved	Decimal	Do not use
280	NETWORK ID	Hexadecimal	Default: 0 READ ONLY
281	DEVICE ADDRESS	Hexadecimal	Default: 0

NOTE 1: The “Over The Air Activation” (OTAA) mode uses a JOIN phase before being able to transmit on the network. This mode uses the APP_ EUI (S214 and S215) and APP_KEY (S216 to S219) codes during this phase to create the keys for network communication. Once this phase is completed, the codes APP_sKEY, NWK_sKEY and DEVICE ADDRESS will be present in the corresponding registers. A new JOIN phase is started every time the device exits Command mode, a reset is performed, or the device is turned on.
Codes:
• APP_EUI identifier for global use (provided by default by adeunis®)
• APP_KEY device application key (provided by default by adeunis®)
The “Activation by personalization” (ABP) mode has no JOIN phase; it transmits directly on the network using the codes NWK_sKEY (S222 to S225), APP_sKEY (S226 to S229) and DEVICE ADDRESS (S281) to communicate.
Codes:
• NWK_sKEY network session key (provided by default by adeunis®)
• APP_KEY applicative session key (provided by default by adeunis®)
• DEVICE ADDRESS Address of the device in the network (provided by default by adeunis®)

Register	Size (bytes)	Base	Description	Default Value	Range (Min-Max)	Comments
303	1	10	LoRaWAN Confirmed mode	0	0-1	LoRaWAN only – activation or deactivation of the confirmed mode 0: deactivation 1: activation
312	4	10	Maximum delay between 2 authentication attempts	43200 (12h)	60-2592000	X 1 second ⇨ Period : 1 minute to 30 days
313	2	10	Weighting factor for initial authentication attempts	1	1-65535	
314	1	10	Number of tries for each authentication attempt	10	1-255	

1.3.2 Sigfox Network Registers

Register	Size (bytes)	Base	Description	Default Value	Range (Min-Max)	Comments
307	2	10	Sigfox Downlink period	1440 (24h)	0-65535	X 1 minute ⇨ Period: 1 min to 45 days
317	1	10	Sigfox Duty Cycle	1	0-1	0: duty cycle activated 1: duty cycle deactivated

1.3.3 NB-IoT Network Registers

Register	**Size (bytes)**	**Base**	**Description**	**Default Value**	**Range (Min-Max)**	**Comments**
303	4	16	Frequency Bands configuration	0x00080084	0 - 0xFFFFFFFF	
305	4	10	Operator selection	0	0 - 4294967295	MCC/MNC of the network operator Use 0 for automatic operator selection
307	31	ASCII	Access Point Name (APN)	“”	-	max 31 characters
312	31	ASCII	IP address (or domain name) of remote server	“”	-	max 31 characters
313	2	10	Port of remote server	0	65535	
314	2	10	Local port	0	65535	

2. RADIO PROTOCOL

Data with size greater than 1 byte will be transmitted MSB first.
In LoRaWAN, frames are sent on port 1.

2.1 Status byte

All frames sent by the product contain a status byte. Its format is identical for all IoT Adeunis products.

Alarm Status	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	Frame Counter			AppFlag2	AppFlag1	Timestamp	Low Bat	Config
No Error	0x00 to 0x07			0	0	0	0	0
Configuration done				0	0	0	0	1
Low bat				0	0	0	1	0
Timestamp				0	0	1	0	0
AppFlag1				0	1	0	0	0
AppFlag2				1	0	0	0	0

The status byte provides two bits reserved for a specific use of each product (AppFlag1 and AppFlag2).
For this product:

- AppFlag1: configuration inconsistency
  - Samples lost in periodic data frame because the payload is not enough.

2.2 Uplink Frame format

2.2.1 Product configuration (0x10)

2.2.1.1 LoRaWAN EU868 and NB-IoT

This frame is sent following the reception of a frame with code 0x01, or at the start of the product.

Offset (in byte)	Data	Description
0	0x10	Frame code
1	Status	Status byte
2	S306	Product mode
3 – 4	S301	Transmit period, expressed in number of historizations
5	S320	Input configuration (Channels A et B)
6 - 7	S321	Historization period (x2 seconds)
8	S322	Debounce durations (channels A and B)
9 – 10	S325	Flow calculation period (minute)
11 – 12	S326	Flow threshold (channel A)
13 – 14	S327	Flow threshold (channel B)
15 – 16	S328	Leak threshold (channel A)
17 – 18	S329	Leak threshold (channel B)
19 – 20	S330	Number of daily periods under leak threshold (channel A)
21 – 22	S331	Number of daily periods under leak threshold (channel B)
23	S332	Sampling period for tamper 1
24	S333	Number of sampling necessary before sending the tamper alarm for tamper 1
25	S334	Sampling period for tamper 2
26	S335	Number of sampling necessary before sending the tamper alarm for tamper 2
27	S340	Number of redundant samples per frame

Decoding example:

Offset (in byte)	Data	Description
0	0x10	Frame code
1	0x00	Frame counter: 0 Bit1@0: configuration consistent
2	0x01	mode PRODUCTION activated
3 – 4	0x0002	S301=0x0002 = 2 (decimal): 1 sending every 2 historizations/savings.
5	0x39	: input configuration (Channels A and B): • Channel A: activated, meter different than gas, tamper input activated • Channel B: activated, gas meter and tamper input deactivated
6 - 7	0x012C	C=300 (decimal), so 1 historization every 10 minutes (300x2sec=600)
8	0x57	Debounce durations Channel A = 500ms and Channel B = 100ms
9 – 10	0x003C	=60 decimal, flow calculation period is set to 60min
11 – 12	0x2710	=10 000 decimal, over-flow threshold detection on channel A set to 10 000 impulses per hour
13 – 14	0x7530	=30 000 decimal, over-flow threshold detection on channel B set to 30 000 impulses per hour
15 – 16	0x000A	=10 decimal, threshold tamper detection Channel A set to 10 impulses per hour
17 – 18	0x0000	threshold tamper detection Channel B set to 0 impulse per hour
19 – 20	0x0003	number of daily periods under tamper threshold (Channel A) set to 3
21 – 22	0x0005	number of daily periods under tamper threshold (Channel B) set to 5
23	0x01	sampling period of tamper 1 set to 1
24	0x03	number of sampling necessary before tamper alarm for tamper 1 set to 3
25	0x06	sampling period of tamper 2 set to 6
26	0x0A	number of sampling necessary before tamper alarm for tamper 2 set to 10
27	0x0D	number of redundant samples per frame set to 13

2.2.1.1 Sigfox / LoRaWAN US915 / LoRaWAN AS923

These frames are sent following the reception of a frame with code 0x01, or at the start of the product.

Offset (in byte)	Data	Description
0	0x10	Frame code
1	Status	Status byte
2	S306	Product mode
3 – 4	S301	Transmit period, expressed in number of historizations
5	S320	Input configuration (Channels A et B)
6 - 7	S321	Historization period (x2 seconds)
8	S322	Anti-bounce filter period (channels A and B)
9 – 10	S325	Flow calculation period (minute)

Decoding example:

Offset (in byte)	Data	Description
0	0x10	Frame code
1	0x00	Frame counter: 0 Bit1@0: configuration consistent
2	0x01	mode PRODUCTION activated
3 – 4	0x0002	S301=0x0002 = 2 (decimal): 1 sending every 2 historizations/savings.
5	0x39	Input configuration (Channels A and B): • Channel A: activated, meter different than gas, tamper input activated • Channel B: activated, gas meter and tamper input deactivated
6 - 7	0x012C	C=300 (decimal), so 1 historization every 10 minutes (300x2sec=600)
8	0x57	anti-bounce filter Channel A = 500ms and Channel B = 100ms
9 – 10	0x003C	=60 decimal, flow calculation period is set to 60min

In order to optimize the sending of the start frames, the 0x11 frame is only sent if the over-flow or leak alarm is active. If at least one of the following conditions is checked, the frame is sent:

- S326! = 0
- S327! = 0
- S330! = 0
- S331! = 0

Offset (in byte)	Data	Description
0	0x11	Frame code
1	Status	Status byte
2 - 3	S326	Flow threshold (channel A)
4 - 5	S327	Flow threshold (channel B)
6 - 7	S328	Leak threshold (channel A)
8 - 9	S329	Leak threshold (channel B)

Decoding example:

Offset (in byte)	Data	Description
0	0x11	Frame code
1	0x20	Frame counter: 1 Bit1@0: configuration consistent
2 - 3	0x2710	=10 000 decimal, over-flow threshold detection on channel A set to 10 000 impulses per hour
4 - 5	0x7530	=30 000 decimal, over-flow threshold detection on channel B set to 30 000 impulses per hour
6 - 7	0x000A	=10 decimal, threshold tamper detection Channel A set to 10 impulses per hour
8 - 9	0x0000	threshold tamper detection Channel B set to 0 impulse per hour

To optimize the sending of start frames, the 0x12 frame is only sent if the leak or fraud alarm is active or if there is redundancy. If at least one of the following conditions is checked, the frame is sent:

- S330! = 0
- S331! = 0
- (S320 & 0x88)! = 0
- S340! = 0

Offset (in byte)	Data	Description
0	0x12	Frame code
1	Status	Status byte
2 - 3	S330	Number of daily periods under leak threshold (channel A)
4 - 5	S331	Number of daily periods under leak threshold (channel B)
6	S332	Sampling period for tamper 1
7	S333	Number of sampling necessary before sending the tamper alarm for tamper 1
8	S334	Sampling period for tamper 2
9	S335	Number of sampling necessary before sending the tamper alarm for tamper 2
10	S340	Number of redundant samples per frame

Decoding example:

Offset (in byte)	Data	Description
0	0x12	Frame code
1	0x40	Frame counter: 2 Bit1@0: configuration consistent
2 - 3	0x0003	number of daily periods under tamper threshold (Channel A) set to 3
4 - 5	0x0005	number of daily periods under tamper threshold (Channel B) set to 5
6	0x01	sampling period of tamper 1 set to 1
7	0x03	number of sampling necessary before tamper alarm for tamper 1 set to 3
8	0x06	sampling period of tamper 2 set to 6
9	0x0A	number of sampling necessary before tamper alarm for tamper 2 set to 10
10	0x0D	number of redundant samples per frame set to 13

2.2.2 Network configuration (0x20)

This frame is sent following the reception of a frame with code 0x02, or at the start of the product.

2.2.2.1 LoRaWAN EU868 / LoRaWAN US915 / LoRaWAN AS923

Offset (in byte)	Data	Description
0	0x20	Frame code
1	Status	Status byte
2	S220	LoRaWAN options Bit 0: Activation of the ADR ON (1)/OFF (0) Bit 1: Reserved Bit 2: DUTYCYCLE ON (1)/DUTYCYCLE OFF (0) Bits 3 & 4: Reserved Bits 5 to 7: Reserved
3	S221	Provisioning mode (0: ABP, 1: OTAA)

Decoding example:

Offset (in byte)	Data	Description
0	0x20	Frame code
1	0x20	Frame counter: 1 Bit1@0: no Low Bat
2	0x05	Duty cycle activated ADR ON
3	0x01	OTAA

2.2.2.2 Sigfox

Offset (in byte)	Data	Description
0	0x20	Frame code
1	Status	Status byte
2	S202	Retry count

Decoding example:

Offset (in byte)	Data	Description
0	0x20	Frame code
1	0x20	Frame counter: 1 Bit1@0: no Low Bat
2	0x02	2 retries

2.2.2.1 NB-IoT

Offset (in byte)	**Data**	**Description**
0	0x20	Frame code
1	Status	Status byte
2 - 32	S312	ASCII string of IP address (or domain name) of remote server
33 - 34	S313	Port of remote server
35 -36	S314	Local port
37 - 67	S307	ASCII string of Access Point Name (APN)

Decoding example:

Offset (in byte)	Data	Description
0	0x20	Frame code
1	0x20	Frame counter: 1 Bit1@0: no Low Bat
2 - 32	34 36 2E 32 31 38 2E 37 35 2E 33 33 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	“46.218.75.33”
33 - 34	0x26A0	9888
35 - 36	0x2328	9000
37 - 67	69 6F 74 69 6E 74 65 72 6E 65 74 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00	“iotinternet”

2.2.3 Software version (0x37)

This frame is sent at the start of the product only if KARE+ is enabled.

Offset (in byte)	Data	Description
0	0x37	Frame code
1	Status	Status byte
2-4	APP version	Byte 5 : MAJOR Byte 6 : MINOR Byte 7 : PATCH
5-7	RTU version	Byte 5 : MAJOR Byte 6 : MINOR Byte 7 : PATCH

Decoding example:

Offset (in byte)	Data	Description
0	0x37	Frame code
1	0x20	Frame counter: 1 Bit1@0: no LowBat
2-4	0x020100	APP v2.1.0
5-7	0x020001	RTU v2.0.1

2.2.4 Keep alive frame (0x30)

This frame (0x30) is transmitted 24 hours after the startup of the application or after the transmission of the previous Keep Alive frame.

Offset (in byte)	Data	Description
0	0x30	Frame code
1	Status	Status byte
2	Alarms	bit to 1 if the alarm is activated else 0: • Bit 0 – Exceeding flow on channel A • Bit 1 – Exceeding flow on channel B • Bit 2 – Tamper detected on channel A • Bit 3 – Tamper detected on channel B • Bit 4 – Leak detected on channel A • Bit 5 – Leak detected on channel B • Bit 6/7 – Reserved
3 - 4	Max flow - channel A	maximum measured flow on channel A within the last 24 hours
5 - 6	Max flow - channel B	maximum measured flow on channel B within the last 24 hours
7 - 8	Min flow - channel A	minimum measured flow on channel A within the last 24 hours
9 - 10	Min flow - channel B	minimum measured flow on channel B within the last 24 hours
11 - 14	Timestamp	Only for LoRaWAN EU868 or NB-IoT products with timestamping enabled. Timestamp of the frame in EPOCH 2013 format

Decoding example:

Offset (in byte)	Data	Description
0	0x30	Frame code
1	0x22	Frame counter: 1 Bit1@1: Low Bat detected
2	0x19	(00011001) binary which gives: • Bit 0 = 1 – Exceeding flow on channel A • Bit 1 = 0 – No exceeding flow on channel B • Bit 2 = 0 – No tamper detected on channel A • Bit 3 = 1 – Tamper detected on channel B • Bit 4 = 1 – Leak detected on channel A • Bit 5 = 0 – No leak detected on channel B • Bit 6/7 – Reserved
3 - 4	0x310A	= 0x310A so 12,554 pulses per hour
5 - 6	0x12C4	= 0x12C4 so 4,804 pulses per hour
7 - 8	0x0010	= 0x0010 so 16 pulses per hour
9 - 10	0x0000	= 0x0000 so 0 pulse per hour

2.2.5 Periodic data without historization (0x46)

This frame (0x46) is transmitted at the frequency defined in register S321 and only if register 301 is set to 1.

Offset (in byte)	Data	Description
0	0x46	Frame code
1	Status	Status byte
2 – 5	Counter - channel A	Counter value for channel A when transmitting the frame
6 - 9	Counter - channel B	Counter value for channel B when transmitting the frame
10 - 13	Timestamp	Only for LoRaWAN EU868 or NB-IoT products with timestamping enabled. Timestamp of the last index in EPOCH 2013 format.

Decoding example:

Offset (in byte)	Data	Description
0	0x46	Frame code
1	0x20	Frame counter: 1 Bit1@0: Low Bat not detected
2 – 5	0x00015C4F	= 89,167 pulses
6 - 9	0x0000F74A	= 63,306 pulses

2.2.6 Alarm frame (0x47)

This frame (0x47) is sent if the measured flow of one of the channels exceeds the configured threshold for this channel (registers S326 and S327).

Offset (in byte)	Data	Description
0	0x47	Frame code
1	Status	Status byte
2 – 3	Measured flow - channel A	Measured flow on channel A when detecting the exceeding of flow, in pulses per hour
4 - 5	Measured flow - channel B	Measured flow on channel B when detecting the exceeding of flow, in pulses per hour
6 - 9	Timestamp	Only for LoRaWAN EU868 or NB-IoT products with timestamping enabled. Timestamp of the frame in EPOCH 2013 format

Decoding example:

Offset (in byte)	Data	Description
0	0x47	Frame code
1	0xA0	Frame counter: 5 Bit1@0: Low Bat not detected
2 - 3	0x2904	= 10,500 pulses per hour
4 - 5	0x206C	= 8,300 pulses per hour
6 - 9	0x0ED9C520	Timestamp : 2020-11-23 17:06:40

2.2.7 Periodic frame with historization (0x5A / 0x5B)

These frames (0x5A et 0x5B) are sent, if the corresponding channels are activated (S320), at the period defined by registers S321 x S301.

Maximum number of samples per frame:

- LoRaWAN EU868: 23 index samples (21 samples with time stamping)
- Sigfox: 4 index samples
- LoRaWAN US915 / AS923: 3 index samples
- NB-IoT: 498 index samples (496 samples with time stamping)

Offset (in byte)	Data	Description
0	0x5A / 0x5B	Frame code Channel A: 0x5A Channel B: 0x5B
1	Status	Status byte
2 - 5	Index at t0	WARNING: if max capacity in the frame is reached the warning bit appeared in status byte. In this case, the product will send the most recent samples at the expense of the oldest ones that will be lost.
6 - 7	Variation of the index Between t0 and t-1	
8 - 9	Variation of the index Between t-1 and t-2	
…		
	Timestamp	Only for LoRaWAN EU868 or NB-IoT products with timestamping enabled. Timestamp of the last index in EPOCH 2013 format

Decoding example (for 2 samples):

Offset (in byte)	Data	Description
0	0x5A	this frame is for channel A
1	0x82	Frame counter: 4 Bit1@1: Low Bat detected
2-5	0x00015C4F	89 167 impulses at t0
4-5	0xE6F3	59 123 impulses of difference between t0 and t-1

2.2.8 Response to Get register request (0x31)

Following reception of a downlink frame with the code 0x40, the frame 0x31 is transmitted. It contains all the values of the registers requested in the downlink frame 0x40.

Offset (in byte)	Data	Description
0	0x31	Frame code
1	Status	Status byte
2-3	Value 1	If value 1 is a 2-byte register
4	Value 2	If value 2 is a 1-byte register
5-8	Value 3	If value 3 is a 4-byte register
…		

If an error is detected in the request, the returned 0x31 frame will be empty.

Note: the size of the data registers is variable depending on the register number. Refer to the list of registers to determine the size of each one and to deduce the total size of the data returned by the 0x31 frame.

Decoding example:

Offset (in byte)	Data	Description
0	0x31	Frame code
1	0x80	Frame counter: 4 Bit1@0: Low Bat not detected
2-3	0x1234	4660 (considering that value 1 is a 2-byte register)
4	0xFF	255 (considering that value 2 is a 1-byte register)
5-8	0x00000000	0 (considering that value 3 is a 4-byte register)
…		

2.2.9 Response to Set register request (0x33)

Following reception of a downlink frame with the code 0x41, the frame 0x33 is transmitted. It shows whether the downlink frame (0x41) has been received and gives information on the support status of the latter.

Offset (in byte)	Data	Description
0	0x33	Frame code
1	Status	
2	Request status	- 0x00: N/A - 0x01: success - 0x02: success – no update (value to set is the current register value) - 0x03: error – coherency - 0x04: error – invalid register - 0x05: error – invalid value - 0x06: error – truncated value - 0x07: error – access not allowed - 0x08: error – other reason
3-4	Register Id	Indicates to the user the register that caused the error (only if “Request Status” is different from 0x01).

CAUTION: if the request 0x41 concerns several registers, the device will stop the analysis of the Downlink request at the first error and will send the Status frame with the reason and the identifier of the register concerned.

In the event of an error, if a partial reconfiguration has taken place before the error was detected, the device restarts and returns to its last valid configuration. As a result, you will have to configure the device again with the new data.

Decoding example:

Offset (in byte)	Data	Description
0	0x33	Frame code
1	0x80	Frame counter: 4 Bit1@0: Low Bat not detected
2	0x04	invalid register
3-4	0x013F	319: register S319 does not exist (should be S3XX)

2.2.10 Transmit conditions

Description	Network	Frame code	Sending conditions
Status (product configuration)	LoRaWAN EU868 / NB-IoT	0x10	• Start of the product (switch to OPERATION mode). • Exit configuration mode (AT command) • 0x01 frame reception (product config recovery)
	Sigfox / LoRaWAN US915 / LoRaWAN AS923	0x10, 0x11, 0x12	
Network status	All	0x20	• Start of the product (switch to OPERATION mode). • Out of configuration mode (AT command) • 0x02 frame reception (network config recovery)
Daily frame (keep alive)	All	0x30	• 24 hours have passed since the start or last sending of this frame
Software version	LoRaWAN EU868 / Sigfox	0x37	• Start of the product (only if KARE+ is activated)
Periodic data frame without history	All	0x46	• Start of the product (switch to OPERATION mode). • Exit configuration mode (AT command) • Shipping period reached (period defined by register S321 with S301 to 1)
Alarm frame	All	0x47	• Exceeding the over-flow alarm threshold on one of the two lanes (sending only if over-flow control is activated by writing a different value of zero in the S326 or S327 register).
Periodic data frame with history	All	0x5A 0x5B	• Transmit period reached (period defined by registers S321 and S301) • Frame 0x5A for Track A • Frame 0x5B for track B

2.3 Downlink Frame format

2.3.1 Get applicative configuration (0x01)

Offset (in byte)	Data	Description
0	0x01	Frame code

When the device receives the downlink, it will generate a product configuration frame (0x10).

2.3.2 Get network configuration (0x02)

Offset (in byte)	Data	Description
0	0x02	Frame code

When the device receives the downlink, it will generate a network configuration frame (0x20).

2.3.3 Add offset to pulse counters (0x03)

2.3.3.1 LoRaWAN EU868, LoRaWAN US915, LoRaWAN AS923, NB-IoT (0x03)

This frame allows to add an offset to the counter value on each channel.

Offset (in byte)	Data	Description
0	0x03	Frame code
1 - 4	Offset - channel A	Offset - channel A: numbers of pulses to add to current index of the meter (channel A) (unsigned 32-bits, MSB first)
5 - 8	Offset - channel B	Offset - channel B: numbers of pulses to add to current index of the meter (channel B) (unsigned 32-bits, MSB first)

Coding example:

Offset (in byte)	Data	Description
0	0x03	Frame code
1 - 4	0x00000015	21 pulses to add to channel A counter
5 - 8	0x00000050	80 pulses to add to channel B counter

2.3.3.1 Sigfox (0x03 & 0x04)

These frames allow to add an offset to the counter value on each channel.

Offset (in byte)	Data	Description
0	0x03	Frame code
1 - 4	Offset - channel A	Offset - **channel A**: numbers of pulses to add to current index of the meter (channel A) (unsigned 32-bits, MSB first)

Coding example:

Offset (in byte)	Data	Description
0	0x03	Frame code
1 - 4	0x00000015	21 pulses to add to channel A counter

Offset (in byte)	Data	Description
0	0x04	Frame code
1 - 4	Offset - channel B	Offset - **channel B**: numbers of pulses to add to current index of the meter (channel B) (unsigned 32-bits, MSB first)

Coding example:

Offset (in byte)	Data	Description
0	0x04	Frame code
1 - 4	0x00000050	80 pulses to add to channel A counter

2.3.4 Get registers (0x40)

This frame (0x40) allows you to inform the device through the network that it must send the values of specific S3XX registers in an uplink frame (0x31).

Offset (in byte)	Data	Description
0	0x40	Frame code
1	CONFID1	Index of the register to be sent. The corresponding register is 300 + CONFIDX value.
2	CONFID2	
3	CONFID3	

IMPORTANT: the user can specify several CONF IDs in the downlink frame but it is up to the user's responsibility to verify that according to the protocol, the size of the data available in a downlink will be large enough to contain all the desired data. Otherwise, the application will send only the first values.

In Sigfox mode: backend may request to send 8 bytes in a downlink. All unused bytes should set to 0xFF to ask the product to stop the downlink frame parsing.

Coding example:

Offset (in byte)	Data	Description
0	0x40	Frame code
1	0x00	Get register S300
2	0x14	Get register S320
3	0x20	Get register S332
4-7	0xFFFFFFFF	In SFX: ignored by product

2.3.5 Set registers (0x41)

This frame (0x41) allows you to change the value of requested S3XX registers.

Offset (in byte)	Data	Description
0	0x41	Frame code
1	CONFID1	Index of the register to be changed. The corresponding register is “300 + CONFID1“
2	Value of CONF ID 1	Value to set In this example, its value is contained in 1 byte
3	CONFID2	Index of the register to be changed. The corresponding register is “300 + CONFID2”
4-5	Value of CONF ID 2	Value to set In this example, its value is contained in 2 bytes
…		

Following the sending of the downlink 0x41, the associated uplink 0x33 is immediately returned. If the update of the register(s) went well, the device will perform a backup and begin its restart procedure automatically. In addition, the Config bit of the status byte will be set to 1 in the next scheduled uplink frame (periodic or alarm or keep alive frame) if everything went well.

Coding example:

Offset (in byte)	Data	Description
0	0x41	Frame code
1	0x14	Register to modify is S320
2-3	0x00AA	Value to set in S320 is 170 (S320 is a 2-byte register)
4	0x1D	Register to modify is S329
5	0x02	Value to set in S330 is 2 (S329 is a 1-byte register)
…		

2.3.6 Reboot (0x48)

This frame (0x48) allows you to reboot the device.

Offset (in byte)	Data	Description
0	0x48	Frame code
1-2	delay	Delay before reboot in minutes (from 1 to 65535)

Following the sending of the downlink 0x48, an uplink ACK (0x2F) is sent. After the specified delay, the device will then begin its restart procedure.

Coding example:

Offset (in byte)	Data	Description
0	0x48	Frame code
1-2	0x05A0	Reboot of the product in 24 hours (1440 minutes)

2.3.7 Set time (0x49)

This frame (0x49) allows you to set the time of the device.

Offset (in byte)	Data	Description
0	0x49	Frame code
1-4	Date / time	Date / time to set (EPOCH2013 format). Date / time is valid from 2020/01/01 00:00:00 to 2089/12/31 23:59:59 Use 0xFFFFFFFF value to not change current time.
5	Clock drift compensation	Compensation of the clock drift (in tenth of seconds per day). Valid values are from -100 to 100 (-10.0 to 10.0 seconds per day). Use 0x80 value to not change current drift compensation.

Following the sending of the downlink 0x49, an uplink ACK (0x2F) is sent.

Coding example:

Offset (in byte)	Data	Description
0	0x49	Frame code
1-4	0x0E38F5AC	2020-07-24 17:38:52
5	0xDD	Clock drift compensation of -3.5 seconds per day

2.4 NB-IoT Header

NB-IoT products send and receive UDP frames.
Compared to Sigfox and LoRa frames, NB-IoT frames have an additional header.

2.4.1 Uplink frames

Offset (in byte)	Data	Description
0-7	IMEI	International Mobile Equipment Identity (IMEI) of the product (15 digits in BCD format).
8	Radio Signal quality	Value from 0 to 5.
9-12	Frame counter	Frame counter since product reset.

Decoding example:

Offset (in byte)	Data	Description
0-7	86 84 46 03 81 30 52 80	IMEI : 868446038130528
8	3	Radio Quality : 3 / 5
9-12	10 2A 12 55	Frame counter : 271192661

2.4.2 Downlink frames

Offset (in byte)	Data	Description
0-7	IMEI	International Mobile Equipment Identity (IMEI) of the product (BCD format).

Coding example:

Offset (in byte)	Data	Description
0-7	86 84 46 03 81 30 52 80	IMEI : 868446038130528