SMART DELTA P

Technical Reference Manual

868 EU - LoRaWAN

Applicable for APP versions >= 2.0.2

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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: RUN	In PARK mode, product is not using Radio. In RUN mode, product will send/receive RF uplinks/downlinks.

1.2 Applicative registers

Register	Size (bytes)	Base	Description	Default value	Min-Max Value	Comments
300	2	10	Keep alive period	8640 (24h)	2 ... 65535	X 10 seconds
301	2	10	Transmit period and observation windows of data for sensors	20	1 ... 360	'Observation windows', default value 20 samples. Number of backups (history logs) to be done before: • **Aggregate evaluation and detector analysis** • sending a frame (thus defining the sending period).
308	4	16	LED activity	0x7F	0 … 0x3FFFF	Default 0x7F, other values: reserved
320	2	10	History period for Delta Pressure and Analog channel	1	1 ... 65535	Number of readings to be performed before saving in the history logs. The value 1 is equivalent to 1 backup per reading. • Additional readings are only used for alarm evaluation. • Additional readings are never taken into account by the detector or for aggregate evaluation.
321	2	10	Sampling period	15 (30s)	1 ... 65535	X 2 seconds
325	2	16	Delta P sensor, aggregates list	1 Average	<Bit> 0. Average 1. Variance 2. Standard Deviation 3. Skewness 4. Kurtosis 5. Median 6. Gradient 7. Peak counter 8. Average crossing counter 9. Min & Max	0 ➔ Raw data, periodic frame 0x53 ≠ 0 ➔ aggregate data, frame 0x67 Bits<15:13> reserved Bits <11:0> 1 bit per aggregate Bit i = 0 ➔ aggregate OFF Bit i = 1 ➔ aggregate ON Coding example 0x0083 = means, variance, peak counter variance, pics ➔ Bit 0 = 1 = Moyenne ON ➔ Bit 1 = 1 = variance ON ➔ Bits <2-6> = 0, aggregates 2 to 6 OFF ➔ Bit 7 = 1 = Peak Counter ON ➔ Bit <8-12> = 0, aggregates ≥ 8 OFF

Register	Size (bytes)	Base	Description	Default value	Min-Max Value	Comments
326	2	16	0-10V sensor, aggregates list	1 Average	Same as 325	0 ➔ Raw data, periodic frame 0x55 ≠ 0 ➔ aggregate data, periodic frame 0x67 Same as 325
355	2	10	Delta P Sensor, peak delta	1	1-359	Unit sample Peak detection every 'n' samples
356	2	10	0-10V sensor, Peak delta	1	Same as above	Same as above
357	2	11	Delta P Sensor, low threshold	-200	+32767/-32768	Signed value (unit Pa)
358	2	11	0-10V sensor, low threshold	0	Same as above	Signed value (unit 1/1000 V)
359	2	11	Delta P Sensor, high threshold	30	+32767/-32768	Signed value (unit Pa)
360	2	11	0-10V sensor, high threshold	2500	Same as above	Signed value (unit 1/1000 V)

Note: In Smart delta P product, **Delta pressure and analog channel measurements are always performed synchronously**

- **at the same rate**
- **and with the same number of samples** (without oversampling).

1.3 Digital inputs/outputs registers

Register	Size (bytes)	Base	Description	Default value	Min-Max value		Comments
380	1	16	Digital Input/Output 1 Configuration	0x00	<7:4> debounce duration 0: no debounce 1: 10 ms 2: 20 ms 3: 50 ms 4: 100 ms 5: 200 ms 6: 500 ms 7: 1 s 8: 2 s 9: 5 s A: 10 s	B: 20 s C: 40 s D: 60 s E: 5 minutes F: 10 minutes <3:0> Type 0 = Deactivated 1 = Event ON 2 = Event OFF 3 = Event ON/OFF 4 = Output	
381	2	10	Digital I/O 1 threshold	1	1 – 65535		Number of detections before to send the frame
382	1	16	Digital input/output2 Configuration	0x00	<7:4> debounce duration 0: no debounce 1: 10 ms 2: 20 ms 3: 50 ms 4: 100 ms 5: 200 ms 6: 500 ms 7: 1 s 8: 2 s 9: 5 s A: 10 s	B: 20 s C: 40 s D: 60 s E: 5 minutes F: 10 minutes <3:0> Type 0 = Deactivated 1 = Event ON 2 = Event OFF 3 = Event ON/OFF 4=Output ON	

383	2	10	Digital I/O 2 threshold	1	1 – 65535	Number of detections before to send the frame alarm
390	4	10	Digital input 1 global counter	0	0 – 2^{32}-1	In-RAM counters that stores all the detected events on the channel This register is not saved in EEPROM. Its value is therefore set to 0 if the product is not powered anymore
391	4	10	Digital input 2 global counter	0	0 – 2^{32}-1	
392	1	10	Digital input 1 output state	0 (OFF)	0 (OFF / OPEN) – 1 (ON / CLOSED)	If channel is configured as an output, this register determines its state. This register is not saved in EEPROM. Its value is therefore set to 0 if the product is not powered anymore
393	1	10	Digital input 2 output state	0 (OFF)	0 (OFF / OPEN) – 1 (ON / CLOSED)	

1.4 Radio registers

1.4.1 LoRaWAN Network Registers

Register	Description	Encoding	Details
201	Spreading Factor (SF) by default (Read Only)	Decimal	Default: 12 Min/max: 4 to 12 Unit: None
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 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.
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	
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)	Minimum required Application version	Comments
303	1	10	LoRaWAN Confirmed mode	0	0-1	V1.2.0	LoRaWAN only – activation or deactivation of the confirmed mode 0: deactivation 1: activation

1.5 Coherency check

A configuration coherency check is made at the time of the backup.
Cases where backups are refused because considered as inconsistent:

Cases refused	Note
Sensor, High threshold < Sensor low threshold	Aggregate peak unevaluable
peak delta > observation windows	Aggregate peak unevaluable
Alarm settings inconsistency High threshold + hysteresis < low threshold + hysteresis	NOT SUPPORTED

2 RADIO PROTOCOL

Data with size greater than 1 byte will be transmitted MSB first.
In LoRaWAN, frames are sent on port 1.
Reminder: Lora Wan 868, max uplink and downlink payload is 51 bytes

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 (FC)			**AppFlag2**	**AppFlag1**	HW	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
Detector Error				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 sufficient.
- AppFlag2: evaluation issue (armed only in 0x67 uplink)
  - at least 1 aggregate cannot be evaluated. In such case value will be set to max coding value (32767 for 16bits signed value, and 65535 for 16 bits unsigned value.

2.2 Uplink Frame format

2.2.1 SMART DELTA P configuration (0x10)

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

Offset	Data	Description
0	0x10	Frame code
1	Status	Status byte
2-3	S300	Transmission period of the Keep Alive frame
4-5	S301	Sensor's transmission period
6-7	S320	Oversampling
8-9	S321	Sensor's sampling period
8-15	S325 S355 S357 S359	Delta P sensor setup (Aggregate or raw + peak detector)
15-23	S326 S356 S358 S360	0-10V sensor setup (Aggregate or raw + peak detector)
24	S361	UUID anomaly detector
25	S364	UUID fouling detector
26	Detector setup	Bit <7 :6> anomaly detector setup 0 ➔ Off 1 ➔ On event 2 ➔ TX always 3 ➔ Setup inconsistency

Offset	Data	Description
		Bit <3 :2> Fouling detector setup 0 ➔ Off 1 ➔ On event 2 ➔ TX always 3 ➔ Setup inconsistency

2.2.2 Digital inputs/outputs configuration (0x1F)

If one of the digital inputs/outputs is active, the frame 0x1F is sent at the start of the product.

Offset (in byte)	Data	Description
0	0x1F	Frame code
1	Status	Status byte
2	S380	Configuration Digital input/output 1
3-4	S381	Threshold of the Digital input 1
5	S382	Configuration Digital input/output 2
6-7	S383	Threshold of the Digital input 2

Decoding example:

Offset (in byte)	Data	Description
0	0x1F	Frame code
1	0x00	Frame counter: 0 No error
2	0x41	Event ON, debounce of 100 ms
3-4	0x0001	1 event before sending the frame
5	0x00	Digital input 2 disabled
6-7	0x0001	1 event before sending the frame

2.2.3 Network configuration (0x20)

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

2.2.3.1 LoRaWAN 868

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 Bit 5: CLASS A (0) Bits 6 to 7: Reserved
3	S221	Provisioning mode (0: ABP, 1:OTAA)

Decoding example:

Offset (in byte)	Data	Description
0	0x20	Frame code
1	0x00	Frame counter: 0 No error
2	0x05	CLASS A Duty cycle activated ADR ON
3	0x01	OTAA

2.2.4 Keep alive frame (0x30)

This frame is sent after an amount of time determined by S300 register or if the magnet is detected in PRODUCTION mode.

Offset (in byte)	Data	**Description**	**VR**
0	0x30	Frame code	
1	Status	Status byte	
2-3	Delta Pression Min	Statistic of the past 24H	
4-5	Delta Pression Max		
6-7	Delta Pression average		
8-9	0/10V Min		
10-11	0/10V Max		
12-13	0/10V average		
14	Anomaly number	Number or anomalies detected in the last 24H	
15	Fouling number	Statistic performed by the fouling detector for the past 24H	
16	Transition number		
17	Anomaly number		
16	Anomaly detector ID	Model Identifier	
17	Fouling detector ID	Model Identifier	
18	Detector setup	Bit <7 :6> Anomaly detector 0 ➔ inactive 1 ➔ TX on event only 2 ➔ TX always 3 ➔ Parameter inconsistency Bit <3 :2> Fouling detector 0 ➔ inactive 1 ➔ TX on event only 2 ➔ TX always 3 ➔ Parameter inconsistency	

Note: Fouling detector is not managed; associated field are filled with 0.

2.2.5 Periodic frames (data / aggregate / anomaly)

The sending frequency for periodic frame is defined by: S321 * S301.

Reminder: the periodic frame 0x53 and 0x55 are sent when “aggregates list” registers are set to 0.
When “aggregate list” registers are ≠ 0, the frame 0x67 is sent periodically.

2.2.5.1 Delta P (0x53)

Maximum number of samples per frame:

- LoRaWAN 868: 24 samples

Offset (in byte)	Data	Description
0	0x53	Frame code
1	Status	Status byte
2-3	Delta P t=0	Measure at t=0 Resolution, Unit = 1 Pa
4-5	Delta P t=-1	Measure at t=-1
6-7	Delta P t=-2	Measure at t=-2
8-9	Delta P t=-3	Measure at t=-3
10-11	Delta P t=-4	Measure at t=-4
…	…	

Decoding example (for 2 samples):

Offset (in byte)	Data	Description
0	0x53	Frame code
1	0x80	Frame counter: 4 and No error
2-3	0x0140	320 Pa
4-5	0x0190	400 Pa

2.2.5.2 Analog (0-10V) (0x55)

Maximum number of samples per frame and per channel:

- LoRaWAN 868: 24 samples

Offset (in byte)	Data	Description
0	0x55	Frame code
1	Status	Status byte
2-3	0-10V t=0	Measure at t=0 Resolution, Unit = 1/1000 V
4-5	0-10V t=-1	Measure at t=-1
6-7	0-10V t=-2	Measure at t=-2
8-9	0-10V t=-3	Measure at t=-3
10-11	0-10V t=-4	Measure at t=-4
…	…	

Decoding example (for 2 samples):

Offset (in byte)	Data	Description
0	0x55	Frame code
1	0x20	Frame counter: 1 No error
2-3	0x2580	9 600 mV
4-5	0x2710	10 000 mV

2.2.5.3 Aggregated data (0x67)

Content:

- Apply to Delta Pressure and analog sensors.
- a frame should have aggregated data for 1 or 2 sensors.
- Required aggregates are sorted (from lower 0, to upper 9)
- Aggregate size is 2 bytes expected for “min/max” aggregate (4 bytes instead of 2).

Offset (in byte)	Data	Description
0	FC = 0x67	Frame code
1	Status	Status byte
2-3	**Id sensor i and associated aggregate list**	16 bits filed <15 :0> Bits <15 :13>: sensor identifier 0: delta pressure 1: 0-10V Bits <12 :0> Bit i = 1 aggregate is available/embedded
Min 2 bytes Max 22 bytes	Aggregate 0 sensor i	Embedded if bit 0 = 1 in Bits <12 :0>
	Aggregate 1 sensor i	Embedded if bit 1 = 1 in Bits <12 :0>
	…	
	Aggregate 9 sensor i	Embedded if bit 9 = 1 in Bits <12 :0>
	Id sensor j and associated aggregate list	
Min 2 bytes Max 22 bytes	Aggregate 0 sensor j	Embedded if bit 0 = 1 in Bits <12 :0>
	Aggregate 1 sensor j	Embedded if bit 1 = 1 in Bits <12 :0>
	…	
	Aggregate 9 sensor j	Embedded if bit 9 = 1 in Bits <12 :0>

Example: all (10) aggregates for sensor 0 (delta P) and sensor 1 (0-10V)

	Content	**Bytes 0-1 Header**	**Bytes 2-3 ID/List**	**Bytes 4-25 Agrégats**	**Bytes 26-27 ID/List**	**Bytes 28-49 Agrégats**
Frame	Sensor 0 and 1 with 10 aggregates	FC + Status	0x03FF (sensor 0)	Aggregates [0..9]	0x23FF (sensor 1)	Aggregates [0..9]

Ex Trame 1 67A003FF0BBB000200030004000500060007000800090000A000B23FF0BBB000200030004000500060007000800090000A000B

2.2.5.4 Anomaly localization (0x68)

When 1 or several anomalies are detected over the current observation windows, an anomaly transaction is performed ➔ transmission of 1 up to 36 uplinks.

- A transaction allows to send anomaly positions and associated input data (raw sample or aggregate)
- Each uplink of the same transaction embeds:
  - A transaction identifier (0-3)
  - Data type (raw or aggregate)
  - Position in observation windows (from 0 up to 35)
    Uplink 0 = beginning of observation windows (oldest data), sample 1 up to 10
    Uplink 1 = next data in the observation windows, sample 11 up to 21
    ….
  - Expected frame number (for the transaction)
  - Sampling period and windows duration (samples number). Possible usage: T sample timestamping using the reception timestamp of the LoRa Frame.

CAUTION: if all frames evaluated on observation windows N cannot be transmitted during the next (N+1) observation windows, a flag will be set in the next transaction (“Bit14” = 1 in “Position/Data type)

Offset (in byte)	Data	Description	
0	FC = 0x68	Frame code	Common detector part
1	Status	Status Byte	
2	UUID	UUID transaction identifier and current frame number Bits <7 :6> transaction identifier, 0-3 (modulo 4) Bits <5 :0>: frame number (0-63) 0: 1st frame of transaction … 35: 36 Frame (observation windows = 360 samples)	
3-4	Data type and anomalies position	Bits <15> detector input data 0 ➔ Raw sample 1 ➔ aggregate Bit <14> 1 ➔ partial previous transaction Bits <13:10> : free/unused Bits <9 :0> anomaly status for sample. A bit set to 1 indicates an anomaly for associated data. Bit 0 = anomaly status for 1st sample of sensors .. Bit 9 = anomaly status for 10th sample of sensors	
5	Total frame	Total number of frame number of the transaction (1-36)	
6-7	Sampling period	0-65535, unit 2s	
8-9	windows duration	“in” Samples number 1-360	
Taille variable (2– 20 octets)	Sample sensor 0 Delta P	1-10 raw samples or 1 aggregate	Detector specific
Taille variable (2– 20 octets)	Sample sensor 1 0-10V	1-10 raw samples or 1 aggregate	

Example: for an observation windows of 24 samples, a transaction will be performed with 3 uplinks transmission.

2.2.5.5 Sensors unit and coding value

	Reminder				Raw frame	Aggregate frame	
Sensor	**Resolution / unit / range**				**Raw data**	**Calculated aggregate.** Average, Variance, Standard deviation, Skewness, Kurtosis	**« Raw » aggregate** Median, Gradient, Min et Max
S0/ Delta P	1	Pa	-500	+500	1 Pa	1/10 Pa	1 Pa
S1/ 0-10V	1/1000	V	0	10.24	1/1000 V	1/1000 V	1/1000 V

Above an illustration of aggregate conversion vs raw frame conversion (json output form Adeunis Code)

Frame 0x67 aggregate data	Frame 0x53 / 0x55 Raw Data

Frame: 6750022100FB001A000A0801
 	
"name": "Sensor0 delta P",
"unit": "pa",
"agregat": [
{
"mean": {
"value": 25.1 //resolution 1/10
},
"mediane": {
"value": 26 //resolution 1
},
"min": {
"value": 10 //resolution 1
},
"max": {
"value": 2049 //resolution 1
}
}
	Frame: 53802802F001
	« deltaPressure » : {
	« unit » : « pa »,
	« values » : [
	10242, //Resolution 1
	-4095
	]
	}

Frame: 6750222100FB001A000A0801
 	
"name": "Sensor1 Ana",
"unit": "V",
"agregat": [
{
"mean": {
"value": 0.251 //resolution 1/1000
},
"mediane": {
"value": 0.026 //resolution 1/1000
},
"min": {
"value": 0.01 //resolution 1/1000
},
"max": {
"value": 2.049 //resolution 1/1000
}
}
	Frame: 558028020001
	
	« voltage » : {
	« unit » : « V »,
	« values » : [
	10.242, //Resolution 1/1000
	0.001
	]
	}

2.2.6 Alarms (0x51, 0x52)

2.2.6.1 Digital inputs alarm (0x51 or 0x52)

This frame is sent if a defined number of events has been detected (configured by the user) on the digital input (only if configured as an input).

Offset	Data	Description
0	0x51 or 0x52	Frame code for Digital input 1 or Digital input 2
1	Status	Status byte
2	Digital input state	Bit 1: state of the digital input in the last frame • 0: OFF (opened) • 1: ON (closed) Bit 0: current state of the digital input • 0: OFF (opened) • 1: ON (closed)
3-6	Global counter	Restart from 0 when max is attempt
7-8	Instantaneous counter	Reset to 0 at each frame

Decoding example:

Offset	Data	Description
0	0x51	Frame code for Digital input 1
1	0x20	Frame counter: 1 No error
2	0x01	@0 = The input 1 was OFF on the last frame @1= The input 1 is ON now
3-6	0x0000017E	382 events since the startup of the device
7-8	0x0001	1 event since last frame

2.2.7 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	0x20	Frame counter: 1 No error
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)
…		

2.2.8 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	0x20	Frame counter: 1 No error
2	0x04	invalid register
3-4	0x018F	399: register S399 does not exist (should be S3XX)

2.2.9 Generic ACK downlink (0x2F)

Following reception of a downlink frame from uplinks code: 0x60, 0x61, 0x09, 0x0A the frame 0x2F is transmitted as an acknowledgement.

Offset (in byte)	**Data**	**Description**
0	0x2F	Frame code
1	Status	
2	Downlink Framecode	Indicate which downlink has generated this uplink
3	Request status	- 0x00 : N/A - 0x01 : success - 0x02 : error – generic - 0x03 : error – wrong state - 0x04 : error – invalid request - 0x05 : HW error

		- 0x06 : RTU error - 0x07 : ongoing state / transaction - Other : reserved for future
xx	Optional field	For 0x07 : ongoing transaction

2.2.10 Transmit conditions

Frame code	Description	Sending conditions	Note
0x10	Status (configuration)	• Product start up • Exit configuration mode • Reception of frame 0x01 (get product config)	
0x1F	Status (Digital inputs/outputs setup)	• Product start up if Digital inputs are active • Exit configuration mode	
0x20	Network configuration	• Product start up • Exit configuration mode • Reception of frame 0x02 (get network config)	
0x30	Keep alive	• Periodically if no periodical data is defined • Magnet detection in PRODUCTION mode	
0x51 0x52	Digital inputs alarms	• Threshold of events overpassed	
0x53	Delta P Periodic data	• Periodically	Note Detector
0x55	0-10V Periodic data	• Periodically	Note Detector
0x67	Periodic aggregated data	• Periodically (end of windows)	Note Detector
0x68	Anomaly localization	• At end of period if an anomaly has been trigged	Note Detector
0x31	Response to 0x40	• Reception of frame 0x40 (content of register)	
0x33	Response to 0x41	• Reception of frame 0x41 (change configuration)	
0x2F	Generic Acknowledgement	• Reception of frame - 0x60/0x61(output control) - 0x09/0x0A (anomaly detector setup)	

Note detector: when the anomaly detector is turn ON, the transmit conditions of periodic frame is driven by:

1. Detection of anomaly in the sampled data at the end of period,
2. and the detector transmission setup: transmission on Event or Always.

For "**transmission on Event**":

⇨ At end of period, if no anomaly is detected over the sampled data, there is no transmission,

⇨ If at least one anomaly is detected, 0x68 uplinks (1 or several) are transmitted.

For "**transmission "always**" :

⇨ If an anomaly is detected over the previous period, transmission of 0x68 uplink,

⇨ Else transmission of uplink 0x67 or 0x55/0x53 according to sensor setup (S325 for Delta P and S236 for 0-10V)

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 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.

2.3.4 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	0x1E	Register to modify is S330
5	0x02	Value to set in S330 is 2(S330 is a 1-byte register)
…		

2.3.5 Output control (0x60, 0x61)

The device can receive a downlink to change the state of one or both digital outputs.

2.3.5.1 Activation of Digital Outputs frame

Offset (in byte)	Data	Description
0	0x60	Frame code
1	State of the Digital Output 1	0: N/A 1: OFF 2: ON
2	State of the Digital Output 2	0: N/A 1: OFF 2: ON
3	Downlink ack request	1: a confirmation uplink is sent to indicate the status of the downlink reception (0x2F)

PAY ATTENTION: in case of erroneous data, for example if the Digital inputs are not configured as outputs, the digital state will be N/A so no action will be done and if an acknowledgement is required the device indicates 'invalid request' as a status in the 0x2F frame.

2.3.5.2 Temporary activation (pulse) on the digital output (0x61)

Offset (in byte)	Data	Description
0	0x61	Frame code
1	Digital Output 1 pulse duration	X0.1s
2	Digital Output 2 pulse duration	X0.1s
3	Downlink ack request	1: a confirmation uplink is sent to indicate the status of the downlink reception (0x2F)

PAY ATTENTION: in case of erroneous data, for example if the Digital inputs are not configured as outputs, the digital state will be N/A so no action will be done and if an acknowledgement is required the device indicates 'invalid request' as a status in the 0x2F frame.