MOTION V2

Technical Reference Manual

868 EU - LoRaWAN / Sigfox

Applicable for APP versions >= 2.0.0

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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: 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	Periodic transmission frequency	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.
308	4	16	LED activity	0x4007F	0-0xFFFFFFFF	Default: 4007F Eco mode: 40070 Other values: reserved
320	2	10	Historization frequency	1	1 ... 65535	Number of samplings to be performed before saving in the history logs The value 1 is equivalent to 1 backup per reading
321	2	10	Sampling/ acquisition period	1800 (1h)	0 ... 65535	X 2 seconds
322	2	10	Sensor inhibition for presence detection	30 (5 min)	1 ... 65535	X 10 seconds Correspond to the wait time before reauthorizing presence detection.
330	1	10	Presence alarm activation	0 (OFF)	0: not activated 1: activated	
340	1	10	Alarm type for brightness	0 (inactive)	0: Inactive 1: Low threshold 2: High threshold 3: Both thresholds	
341	1	10	High threshold value	0	0 … 100	%
342	1	10	High threshold hysteresis	0	0 … 100	%
343	1	10	Low threshold value	0	0 … 100	%

344	1	10	Low threshold hysteresis	0	0 … 100	%
380	1	16	Configuration digital input 1 (button)	0x41	<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	
381	2	10	Digital input 1 threshold	1	1 – 65535	Number of detections When the number of detected events becomes above this threshold, an alarm is triggered
382	1	16	Configuration digital input 2	0x0 (deactivated)	<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	
383	2	10	Digital input 2 threshold	1	1 – 65535	Number of detections When the number of detected events becomes above this threshold, an alarm is triggered

390	4	10	Global counter for channel 1	0	0 – 4294967295	In-RAM counter that accumulates the duration in seconds of 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	Global counter for channel 2	0	0 – 4294967295	

1.3 Radio registers

1.3.1 LoRaWAN Network Registers

Register	Description	Encoding	Details
201	Spreading Factor (SF) by default	Decimal	Default: 12 Unit: None *Read Only*
204	Reserved	Hexadecimal	Do not use
214	LORAWAN 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	LORAWAN APP-EUI (second part – MSB)	Hexadecimal	
216	LORAWAN 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	LORAWAN APP-KEY (second part – MID MSB)	Hexadecimal	
218	LORAWAN APP-KEY (third part – MID LSB)	Hexadecimal	
219	LORAWAN 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: DUTY CYCLE ON (1) /DUTY CYCLE 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	LORAWAN NWK_SKEY (first part – MSB)	Hexadecimal	Default: 0 Parameter encoded on 16 bytes. Each of the 4 registers contains 4 bytes.
223	LORAWAN NWK_SKEY (second part - MID MSB)	Hexadecimal	
224	LORAWAN NWK_SKEY (third part - MID LSB)	Hexadecimal	
225	LORAWAN NWK_SKEY (fourth part – LSB)	Hexadecimal	
226	LORAWAN APP_SKEY (first part – MSB)	Hexadecimal	Default: 0 Parameter encoded on 16 bytes. Each of the 4 registers contains 4 bytes.
227	LORAWAN APP_SKEY (second part - MID MSB)	Hexadecimal	
228	LORAWAN APP_SKEY (third part - MID LSB)	Hexadecimal	
229	LORAWAN APP_SKEY (fourth part – LSB)	Hexadecimal	
257	Configuration RX2	Decimal	Default: 1 0: Channel disabled 1: Default configuration: LoRaWAN Other: User configuration
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)	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

1.3.2 Sigfox Network Registers

Register	Size (bytes)	Base	Description	Default Value	Range (Min-Max)	Minimum required Application version	Comments
307	2	10	Sigfox Downlink period	1440 (24h)	0-65535	>= V2.0.0	X 1 minute ⇨ Period: 1 min to 45 days
317	1	10	Sigfox Duty Cycle	1	0-1	V1.2.0	0: duty cycle activated 1: duty cycle deactivated Not displayed anymore in LoRaWAN since 2.0.0

1.4 Coherency check

A configuration coherency check is made at the time of the backup (AT&W).
Cases where backups are refused (AT&W returns "E") because considered as inconsistent:

Cases refused	Description
S340@3 && S343 > S341	Luminosity: low and high thresholds enabled (Low threshold value) (> high threshold value)
S340@3 && S343+S344 > S341-S342	Luminosity: low and high thresholds enabled (Low threshold value + low threshold hysteresis) > (high threshold value – high threshold hysteresis)
S340@1 && S344 + S343 > 100	Luminosity: low threshold enabled (Low threshold value + low threshold hysteresis) > 100
S340@2 && S342 > S341	Luminosity: high threshold enabled (high threshold hysteresis) > (high threshold value)

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			Reserved	AppFlag1	HW	Low Bat	Config
No Error	0x00 to 0x07			X	0	0	0	0
Configuration done				X	0	0	0	1
Low bat				X	0	0	1	0
HW Error				X	0	1	0	0
AppFlag1				X	1	0	0	0
Reserved				X	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 are lost in periodic data frame because the payload is not enough.
- AppFlag2: unused

2.2 Uplink Frame format

2.2.1 Product configuration (0x10)

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
2-3	S300	Transmission period of the Keep Alive frame
4-5	S301	Transmission period of the periodic frame
6-7	S320	History period
8-9	S321	Sampling period
10-11	S322	Inhibition time

Decoding example:

Offset (in byte)	Data	Description
0	0x10	Frame code
1	0x00	Frame counter: 0 Bit1@0: no LowBat
2-3	0x21C0	8640 => 8640 x 10s = 86400s = 24h
4-5	0x0001	1
6-7	0x0001	1
8-9	0x0708	1800 => 1800 x 2s = 3600s = 1h
10-11	0x001E	30 => 30 x 10s = 300s = 5min

2.2.2 Digital inputs configuration (0x1F)

This frame is sent at the start of the product if at least one digital input is activated

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

Decoding example:

Offset (in byte)	Data	Description
0	0x1F	Frame code
1	0x00	Frame counter: 0 Bit1@0: no LowBat
2	0x41	EVENT ON/OFF, debound@100ms
3-4	0x0001	Alarm triggered after one detection
5	0x00	No alarm configured for digital input 2
6-7	0x0000	No threshold value

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.

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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	Provisionning mode (0: ABP, 1: OTAA)

Decoding example:

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

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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 LowBat
2	0x02	2 retries

2.2.4 Keep alive frame (0x30)

This frame is sent after an amount of time determined by S300 register if no periodic data is configured

Offset (in byte)	Data	Description
0	0x30	Frame code

2.2.5 Periodic data frame (0x5C)

The acquisition period is defined by: S321 * S320
The sending frequency is defined by: S321 * S320 * S301
The number of samples per channel is defined by: S301

Each sample is coded on 2 bytes:

- 1 for presence: 8 unsigned bits. Represents occupancy rate (in %) during the concerned period. Example: 50% = a presence detected half the time.
- 1 for brightness: 8 bits unsigned in %. Example: 50 => 50% brightness

Maximum number of samples per frame:

- LoRaWAN 868: 24 samples
- Sigfox 868: 4 samples

Offset (in byte)	Data	Description
0	0x5C	Frame code
1	Status	Status byte
2	Presence state	Presence state when sending the frame: • 0: no presence detected • 1: presence detected
3-4	Presence + luminosity$_{(t0)}$	Measured at t=0
5-6	Presence + luminosity$_{(t-1)}$	Measured at t=-1
6-7	Presence + luminosity$_{(t-2)}$	Measured at t=-2
…	…	

Decoding example:

Offset (in byte)	Data	Description
0	0x5C	Frame code
1	0x80	Frame counter: 4 Bit1@0: LowBat not detected
2	0x01	A presence is currently detected
3-4	0x1E32	0x1E = 30 => a presence has been detected 30% of the time during the concerned period (t-1 to t0) 0x32 = 50 => luminosity measured: 50%
5-6	0x0020	0x00 = 0 => No presence detected during the concerned period (t-2 to t-1) 0x20 = 32 => luminosity measured: 32%

2.2.6 Presence Alarm (0x5D)

If the presence alarm is activated, this frame is sent when the presence detection begins, or ends.

Offset (in byte)	Data	Description
0	0x5D	Frame code
1	Status	Status byte
2	Alarm state	0: inactive alarm (end of presence) 1: active alarm (beginning of presence)
3	Luminosity	Measured luminosity when alarm has occurred

Decoding example:

Offset	Data	Description
0	0x5D	Frame code
1	0x80	Frame counter: 4 Bit1@0: LowBat not detected
2	0x01	Presence detected
3	0x32	50 => luminosity at 50%

2.2.7 Luminosity alarm (0x50)

If the luminosity alarm is activated, this frame is sent when an alarm of exceeding threshold appears or disappears.

Offset (in byte)	Data	Description
0	0x50	Frame code
1	Status	Status byte
2	Alarm state	0: inactive alarm 1: active alarm (threshold exceeded)
3	Luminosity	Measured luminosity when alarm has occurred

Decoding example:

Offset	Data	Description
0	0x50	Frame code
1	0x80	Frame counter: 4 Bit1@0: LowBat not detected
2	0x01	Alarm active
3	0x32	50 => luminosity at 50%

2.2.8 Digital input alarm (0x51/0x52)

This frame is sent when the number of detected events exceed the threshold

Offset (in byte)	Data	Description
0	0x51 0x52	Frame code for digital input 1 (button) Frame code for digital input 2
1	Status	Status byte
2	Alarm state	Define precisely the input/output state (ON/CLOSED : 1, OFF/OPEN : 0) • <0> Channel1 current state • <1> Channel1 state when sending the previous frame
3-6	Global counter	Global counter the detected events
7-8	Instant counter	Number of events detected since the last alarm sending

Decoding example:

Offset	Data	Description
0	0x52	Frame code (digital input2)
1	0x80	Frame counter: 4 Bit1@0: LowBat not detected
2	0x01	Bit0@1 => Current state: ON/CLOSED Bit1@0 => Previous state: OFF/OPENED
3-6	0x000001230	0x1230 => 4656 events detected since the device is in production mode
7-8	0x0003	3 events detected since the last alarm sending

2.2.9 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: LowBat 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)
…		

2.2.10 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: LowBat not detected
2	0x04	invalid register
3-4	0x0020	32: register S032 does not exist (should be S3XX)

2.2.11 Transmit conditions

Frame code	Description	Sending conditions
0x10	Status (configuration)	• Product start up • Exit configuration mode (AT command) • Reception of frame 0x01 (get product config)
0x1F	Digital input configuration	• Product start up if at least one input is activated
0x20	Network configuration	• Product start up • Exit configuration mode (AT command) • Reception of frame 0x02 (get network config)
0x30	Keep alive	• Periodically if no periodical data is defined
0x5C	Periodic data	• Periodically
0x5D	Presence alarm	• Beginning or end of presence
0x50	Luminosity alarm	• Threshold crossing
0x51 0x52	Digital input alarm	• Threshold crossing

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).

2.3.1 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

2.3.2 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)
…		