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LoRaWAN manual and interface description

SAB07

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1. Release Notes

Revision	Date	Description	author
A	27.09.2023	First release	MD; JD
B	29.10.2024	Firmware 4.3 Update	JD
C	26.08.2025	Correction	JD

2. Communication concepts

Communication concepts related to the device's operation

SAB07 LoRaWAN periodically sends messages (keep-alive commands) to the server. The server can then send command to SAB07 and the data will be received in the receiving windows, opened after each sent message, according to the LoRaWAN Class A devices protocol. The messages sent period is strict to the LoRaWAN duty cycle requirements. SAB07 can send both confirmed/unconfirmed uplink messages depending on its configuration.

When a downlink is sent to SAB07, it can be either confirmed or unconfirmed. For critical messages (e.g. initial parameters setup), we recommend using confirmed downlinks, so that the LNS can take care of repetition if required and successful delivery can be verified.

One sent packet from the server may contain multiple commands for SAB07 to optimize the communication efficiency. These sent bytes can combine both multiple write or/and read commands. Response to the GET commands will be sent in the next uplinks.

When the server wants to read some data from the device, the corresponding command code or command codes are sent to the device and the response will be sent together with the next keep-alive message. If the length of the command responses and the keep-alive packet is longer than the allowed by LoRaWAN MAC layer application payload size, the keep-alive packet will be omitted and only the command responses are sent by SAB07.

The aforementioned communication method is also described in Table 1.

Payload byte index	Meaning
0	Command 0 meaning
1	Command 0 data - optional
i	Command 1 meaning - optional
i+1	Command 1 data - optional
j	Command 2 meaning- optional
j+1	Command 2 data - optional
...	...
k	Command x meaning- optional
k+1	Command x data - optional

When the server writes some device configuration with a command, the data is stored in the device non-volatile memory, so there isn't need to send this command again on next network join.

Supported LoRaWAN MAC protocol version: 1.0.3
Supported LoRaWAN device class: A
LoRaWAN MAC Port:

- Uplink: 2.
- Downlink: 1, 2, 4-223;

3. Commands cheat sheet

Messages explanation

Command code [hex]			Command name	Sent from
	Set	Get		
81			Keep-alive	SAB07
	02		Set keep-alive period	Server
		12	Get keep-alive period	Server/ SAB07
03			Recalibrate motor	Server
04			Read device hardware and software version	Server/ SAB07
	06		Set open window detection parameters	Server
		13	Get open window detection parameters	Server/ SAB07
	07		Set child lock parameters	Server
		14	Get child lock parameters	Server/ SAB07
	08		Set temperature ranges	Server
		15	Get temperature ranges	Server/ SAB07
0B			Valve close until over-voltage is detected (also called “force close”)	Server
	0C		Set internal temperature control algorithm parameters	Server
		16	Get internal temperature control algorithm parameters	Server/ SAB07
	0D		Set device online operational mode	Server
		18	Get device online operational mode	Server/ SAB07
	10		Set network join retry period	Server
		19	Get network join retry period	Server/ SAB07
	0E		Set device target tempertature	Server
	2D		Set motor position only	Server
	31		Set a motor position and update the target temperature.	Server
	11		Set uplink messages type	Server
		1B	Get uplink messages type	Server/ SAB07
	1C		Set device radio communication watchdog parameters	Server
		1D	Get device radio communication watchdog parameters	Server/ SAB07
	1E		Set device primary operational mode	Server
		1F	Get device primary operational mode	Server/ SAB07
28			Manual change of target temperature by rotating	SAB07
		29	Get proportional algorithm parameters	Server/SAB07
	2A		Set proportional algorithm parameters	Server
		2B	Get temperature control algorithm in use	Server/SAB07
	2C		Set temperature control algorithm in use	Server
30			Device reset	Server
	33		Set LoRaWAN AppEUI & AppKey	Server
		34	Get child lock behavior when device goes offline	Server/SAB07
	35		Set child lock behavior when device goes offline	Server
		36	Get PI's algo Proportional gain	Server/SAB07
	37		Set PI's algo Proportional gain	Server
	3C		Set External temperature sensor value with accuracy 0.1	Server
		3D	Get PI's algo Integral gain	Server/SAB07
	3E		Set PI's algo Integral gain	Server

Command code [hex] Set	Command code [hex] Get	Command name	Sent from
	3F	Get PI's algo integral value	Server/SAB07
	40	Get PI's algo run period	Server/SAB07
41		Set PI's algo run period	Server
	42	Get PI's algo temperature hysteresis (Thys)	Server/SAB07
43		Set PI's algo temperature hysteresis (Thys)	Server
	44	Get External temperature sensor value	Server/SAB07
45		Set open window detection parameters (0.1 accuracy)	Server
	46	Get open window detection parameters (0.1 accuracy)	Server/SAB07
49		Set anti-freeze settings	Server
	4A	Get anti-freeze settings	Server/SAB07
4C		Set Maximum allowed integral value	Server
	4D	GET Maximum allowed Integral value	Server/SAB07
4E		SET valve openness in percentage	Server
4F		SET Valve openness range in percentage	Server
	50	GET Valve openness range in percentage	Server/SAB07
51		SET Target temperature with resolution 0.1°C	Server
	52	GET Target temperature with resolution 0.1°C	Server/SAB07
53		SET Internal Temperature Offset	Server
	54	GET Internal Temperature Offset	Server/SAB07

4. Communication

4.1. Uplink types

SET

Set uplink messages type command explanation. This command is used to set SAB07 sent uplink message type.	
Byte index	**Hex value – Meaning**
0	0x11 – the command code
1	0x00 – SAB07 unconfirmed uplink messages. (default) 0x01 – SAB07 sends confirmed uplink messages.

Example command: 0x1101 – The server sets SAB07 uplink message type to confirmed.

GET

Get uplink messages type command explanation This command is used to get SAB07 sent uplink messages type. Server sends the command code and the response is sent from SAB07 together with the next keep-alive command. The keep-alive in the response is omitted for clarity.		
Byte index	**Sent request**	**Received response**
0	1B – Command code.	1B – The command code.
1		00 – SAB07 uplinks are unconfirmed; 01 – SAB07 uplinks are confirmed.

Example command sent from server: 0x1B;
Example command response: 0x1B00 => SAB07 sent uplinks are unconfirmed.

4.2. Keep-alive

»KEEP-ALIVE COMMAND EXPLANATION

Periodically sent message which contains the most important device data.

Byte index	Bit index	Hex value - Meaning
0	-	81 – Keep-alive command
1	-	XX – Target Temperature set by the rotary encoder. Currently 0x05 <= XX <= 0x1E
2	-	XX – Temperature measured by the device sensor. t, [°C] = (XX − 28.33333)/5.66666
3	-	XX – Relative Humidity measured by the device sensor. RH, [%] = (XX ∗ 100)/256
4	-	XX – Motor position in steps, bits 7:0
5	-	XX – Motor range in steps, bits 7:0
6	7:4	X – Motor position in steps, bits 11:8
6	3:0	X – Motor range in steps, bits 11:8
7	7:4	X – Battery voltage. Voltage = 2 + X * 0.1, [V]
7	3	Set to 1 if open window functionality is enabled and such condition is met. Cleared otherwise.
7	2	Set to 1 if too high motor current consumption was measured.
7	1	Set to 1 if too low motor current consumption was measured.
7	0	Set to 1 if device temperature sensor is broken, cleared if it works properly.
8	7	Set to 1 if manual temperature set through the rotary encoder is disabled. Set to 0 otherwise.
8	6:0	Reserved for future use
8	6	Set to 1 if device motor calibration fails due to impossibility to detect end of valve position. Cleared otherwise.
8	5	Set to 1 when the device is attached to the backplate.
8	4	Set to 1 when the device is online – joined the network and/or server packets are regularly received. Set to 0 if the device thinks it's offline.
8	3:0	Reserved for future use.

Example keep-alive: 0x811DA878FA2C01F080
Decoding:
0x81 – Command code. Shows that keep-alive data follows
0x1D – Target temperature is 29
0xA8 – Sensor temperature; 0xA8= 168; (168-28.33333)/5.66666) = 24,65°C
0x78 – Sensor humidity; 0x78 = 120; (120*100)/256 = 46,875 %rH
0xFA2C01 – Byte indexes 4, 5 and 6; Motor position = 0x0FA = 250; Motor range = 0x12C = 300;
0xF0 – Battery voltage and status; 0xF = Battery voltage = 2+ 15*0,1 = 3,5VDC; 0x0 = All status flags are cleared.
0x80 – Rotary encoder is disabled (Child Lock is enabled).

SET Keep-alive period

Command explanation Sets the period for the SAB07 keep-alive command messages.	
Byte index	**Hex value – Meaning**
0	02 – The command will set SAB07 keep-alive period.
1	XX – keep-alive period in minutes. Value 0x00 isn't applicable. Default value: 0x0A.

Example command: 0x020A – The example sets the keep-alive period to 10 minutes.

Note that the period value must respect the LoRaWAN messages duty cycle limitations. Otherwise the message will be sent when this is allowed. Also, the bigger period value, the less battery discharge. In most of cases, min. allowed period is 3 minutes and recommended values are 10 minutes or greater.

GET keep-alive period

Command explanation This command is used to get SAB07 period of the keep-alive command messages. Server sends the command code and the response is sent from SAB07 together with the next keep-alive command. The keep-alive in the response is omitted for clarity.		
Byte index	**Sent request**	**Received response**
0	12 – The command code	12 – The command code.
1		XX – device keep-alive period in minutes.

Example command sent from server: 0x12;
Example command response: 0x1209 – SAB07 keep-alive is 9 minutes.

4.3. Manual target temperature change

The command below is used to indicate the application server that the user has changed the target temperature manually - by hand. The command is sent together with the keepalive of the device.

Byte index	**Hex value – Meaning**
0	28 – The command code.
1	XX – New value of the target temperature, in Celsius degrees.

4.4. Operational modes & temperature control algorithm

The device has 4 operation modes:

- **Offline** – device is not connected to the network. This means that the device can't join to the LoRaWAN network or doesn't receive confirmation on the sent keep-alive commands. In this mode the device uses one of the internal temperature control algorithms to achieve target temperature;
- **Manual control** – device is connected to the network; internal temperature control algorithm is disabled. Motor position is determined by the server.
- **Automatic temperature control** - device is connected to the network; internal temperature control algorithm is enabled; Target temperature is determined by the server. **Default online mode**
- **Automatic temperature control with external temperature reading** – device is connected to the network; internal temperature control algorithms are enabled; internal temperature sensor is disabled; Target temperature and sensor reading is determined by the server.

The offline mode is entered automatically when the device has lost connection with the server. If the device later restores its server connection the mode is changed automatically to the previously selected online mode.

SET

Byte index	**Hex value – Meaning**
0	0D – The command code.
1	00 – Online manual control mode. 01 – Online automatic control mode. (default) 02 – Online automatic control mode with external temperature reading.

Example command: 0x0D01 – With the example command, online automatic control mode is chosen.

GET

This command is used to get SAB07 online operational mode. Server sends the command code and the response is sent from SAB07 together with the next keep-alive command.

Byte index	**Sent request**	**Received response**
0	18 – Command code.	18 – The command code.
1		XX – Device online mode value: 00 – Online manual control mode; 01 – Online automatic control mode; 02 – Online automatic control mode with external temperature reading.

Example command sent from server: 0x18;
Example command response: 0x1801 – SAB07 works in online automatic control mode.

4.5. Algorithm - Proportional Integral

This algorithm is an implementation of a typical PI algorithm.

$$ValveOpening[\%] = Kp * e + Ki * \sum e$$

Both the proportional gain Kp and the integral gain Ki can be set with 5 decimal places after the comma.

The algorithm will run on 3 occasions:

- Periodic run (by default every 10 minutes)
- New target temperature is set
- T(measured) - T(target) > 2 degrees Celsius

The implementation does not have integral reset time - it integrates all previous errors. There's an integral anti wind-up and anti wind-down in place, which limits the integral to 0-20 degrees.

$$Integral = \sum e$$

There's a software hysteresis in place, which prevents the movement of the motor unless the error is > Thys.

»MAXIMUM ALLOWED INTEGRAL VALUE

SET

Byte index	Byte value – Meaning
0	4C - The command code
1	XX-I[15:8]
2	XX-I[7:0]

Example command: 0x4C012C
I[15:0] = 012C[HEX] = 300
Integral = I[DEC] / 10 = 300 / 10 = 30
The error is set to its maximum allowed value of 30°C
Default: I[15:0] = 01F4[HEX] = 50[DEC] = 50°C

GET

Byte index	Sent request	Response – Meaning
0	4D – The command code.	4D – The command code.
1		XX-I[15:8]
2		XX-I[7:0]

Example command response: 0x4D03E8
I[15:0] = 03E8[HEX] = 1000
Integral = I[DEC] / 10 = 1000 / 10 = 100
The error is set to its maximum allowed value of 100°C
Default: I[15:0] = 01F4[HEX] = 50[DEC] = 50°C

»PROPORTIONAL GAIN - KP

SET

Byte index	Byte value – Meaning
0	37 - The command code
1	A[23:16]
2	A[15:8]
3	A[7:0]
	A[23:0] = Kp * 131072 (Default value Kp = 6)

Example downlink: Setting Kp to 2.74688: 37 05 7E 67
2.74688*131072 = 360039 = 0x05 7E 6

GET

Byte index	Sent request	Received response
0	36 – The command code.	36 – The command code.
1		A[23:16]
2		A[15:8]
3		A[7:0]
		Kp = A[23:0]/131072

Uplink example: 0x36123456
A[23:0] = 0x123456 = 1193046
Kp = 1193046 / 131072 = 9.1

»INTEGRAL GAIN - KI

SET

Byte index	Byte value – Meaning
0	3E - The command code
1	B[23:16]
2	B[15:8]
3	B[7:0]
	B[23:0] = Ki * 131072 (Default value: Ki = 1)

Example downlink: Setting Ki to 0.412678: 3E 00 D3 4A
0.412678*131072 = 54090 = 0x00D34A

GET

Byte index	Sent request	Received response
0	3D – The command code.	3D – The command code.
1		B[23:16]
2		B[15:8]
3		B[7:0]
		Ki = B[23:0]/131072

Uplink example: 0x3D112233
B[23:0] = 0x112233 = 1122867
Ki = 1122867/131072 = 8.57

»GET THE VALUE OF THE INTEGRAL

Byte index	Sent request	Received response
0	3F – The command code.	3F – The command code.
1		Integral [15:8]
2		Integral [7:0]

The value of the integral is premultiplied by 10 by the device, so it can use 0,1 resolution.

Example uplink:
If the integral is 2.5, the complete command response is going to be: 0x3F0019
Integral [15:0] = 0x0019 = 25
Integral = 25/10 = 2.5

»PI RUN PERIOD

SET

Byte index	Byte value – Meaning
0	41 - The command code
1	XX = Run period in minutes. (Default value: 10 minutes)

Example downlink: 0x410F - sets the run period to 15 minutes.

GET

Byte index	Sent request	Received response
0	40 – The command code.	40 – The command code.
1		XX - Run period in minutes.

Uplink example: 0x400B - the run period is 11 minutes

»TEMPERATURE HYSTERESIS (THYS)

SET

Byte index	Byte value – Meaning
0	43 - The command code
1	XX = Temperature hysteresis value (Thys), multiplied by 10. (Default value: 0.2 deg. C)

Min. acceptable value of Thys is 0.2C

Example downlink: 0x4303 - sets the temperature hysteresis to 0.3 degrees Celsius.

GET

Byte index	Sent request	Received response
0	42 – The command code.	42 – The command code.
1		XX - Temperature hysteresis value, multiplied by 10.

Uplink example: 0x42FF - The temperature hysteresis is 1.6 degrees Celsius.

4.6. External temperature measurement and internal temperature offset

This mode is used when the measurements of SAB07's temperature sensor is not reliable - e.g. there's a cover in front of the radiator.

Keep in mind that this command is only available when the device is in operational mode "**Automatic temperature control with external temperature reading".** To set this operational mode, send downlink "0D02"

When SAB07 is in "**Automatic temperature control with external temperature reading"**, SAB07 reports the set ext. temp value in each keepalive message.
This command is applicable when the device is in online automatic control mode with external temperature reading. The server sends this command to SAB07 device when it has a new measured temperature by the external sensor. This external temperature will be used by SAB07 for the internal temperature control algorithm.

» SET EXTERNAL TEMPERATURE SENSOR VALUE WITH ACCURACY 1.0

Byte index	Hex value – Meaning
0	0F – The command code.
1	XX – The ext. temperature in Celsius degrees. The value must be greater than 0°C!

Example downlink: 0x0F14 – the server notifies SAB07 that the measured temperature by the external sensor is 20 degrees Celsius.

» SET EXTERNAL TEMPERATURE SENSOR VALUE WITH ACCURACY 0.1

The value must be greater than 0°C!

Byte index	Hex value – Meaning
0	3C – The command code.
1	XX - T[15:8]
2	XX - T[7:0]
	XXXX - T[15:0]= t[Celsius] * 10

Example downlink: 0x3C0102 – the server notifies SAB07 that the measured temperature by the external sensor is 25.8 degrees Celsius. 25.8*10 = 258 = 0x0102

» GET EXTERNAL TEMPERATURE SENSOR VALUE WITH ACCURACY 0.1

GET

Byte index	Sent request	Received response
0	44 – Command code.	44 – The command code.
1		T[15:8]
2		T[7:0] t° = T[15:0]/10

Example uplink: 0x440096 - Ext. temp measurement value is 15.0

»INTERNAL TEMPERATURE OFFSET

This command allows you to offset the internally measured temperature by +/- 5°C.

SET

This command sets the desired temperature offset.

Byte index	Sent request	Received response
0	53 – The command code.	53 – The command code.
1		XX – offset parameter value, where XX = (offset, [°C] + 4.928) / 0.176

Tabulated values for example offsets:

Offset, [°C] = (XX - 28) * 0.176 = (0-28)* 0.176=-28* 0.176=-4.928=-5°C

Offset -5°C -> XX = 00[HEX] -> Command: **0x5300**
Offset -4°C -> XX = 05[HEX]-> Command: **0x5305**
Offset -3°C -> XX = 0B[HEX]-> Command: **0x530B**
Offset -2°C -> XX = 11[HEX] -> Command: **0x5311**
Offset -1°C -> XX = 16[HEX] -> Command: **0x5316**
Offset 0°C -> XX = 1C[HEX] -> Command: **0x531C**
Offset 1°C -> XX = 22[HEX] -> Command: **0x5322**
Offset 2°C -> XX = 27[HEX] -> Command: **0x5327**
Offset 3°C -> XX = 2D[HEX] -> Command: **0x532D**
Offset 4°C -> XX = 33[HEX] -> Command: **0x5333**
Offset 5°C -> XX = 38[HEX] -> Command: **0x5338**

GET

This command gets the current temperature offset.

Byte index	Byte value – Meaning
0	54 - The command code
1	XX = offset parameter value

Example command: 0x5438,
38[HEX]=56[DEC]
offset,[°C] = (XX - 28) * 0.176 = (56-28)* 0.176=28* 0.176=4.928=5°C

4.7. Control target temperature and/or motor position

»SET DEVICE TARGET TEMPERATURE WITH RESOLUTION 1.0°C.

This command is applicable only in online automatic control mode or in online automatic control mode with external temperature reading. The command sets the temperature to be reached by the device internal control algorithm. It's described in details in the table below.

Byte index	Hex value – Meaning
0	0E – The command code.
1	XX – The desired temperature in Celsius degrees. The value must be inside the range of allowed device working temperatures (Set with command code 0x08).

Example command: 0x0E16 – sets the device target temperature to 22 Celsius degrees.

»TARGET TEMPERATURE WITH RESOLUTION 0.1°C

SET

The desired target temperature should be pre-multiplied by 10 to get the value to be send.

Byte index	Hex value – Meaning
0	51 - The command code
1	XX – Tt[15:8]
2	XX – Tt[7:0]

Target temperature = Tt [15:0] / 10
Example command: 0x510102 => Tt = 0102[HEX]=258[DEC]
Target temperature = 258 / 10 = 25.8

The desired target temperature should be pre-multiplied by 10 to get the value to be sent.
If later the target temperature is adjusted manually by rotating the device outer ring, the new value will be with accuracy 1.0°C

GET

This command response is automatically prepended to the keep-alive message when the target temperature isn't integer. The device will not respond to server requests with command code 0x52.

Byte index	Sent request	Received response
0	52 – The command code.	52 – The command code.
1		XX – Tt[15:8]
2		XX – Tt[15:8]

Example response: 0x520102 => Tt = 0102[HEX]=258[DEC]
Target temperature = 258 / 10 = 25.8

»SET VALVE OPENNESS IN PERCENTAGE

This command only works in Manual mode.

SET

The desired valve openness in percentage.

Byte index	Hex value – Meaning
0	4E - The command code
1	XX – Valve openness percentage

Example command: 0x4E0A
0A[HEX] = 10 [DEC] = 10%
The valve will open 10% of its maximum capabilities.

»LIMIT MIN/MAX VALVE OPENNESS

This command allows you to decide what's the minimum and maximum valve openness for SAB07 in percentages. It's only applicable when using the internal algorithm for temperature control. For example, you can decide that you want SAB07 to control the valve only between 20% and 60% valve openness.

- If SAB07 has to heat the room, it'll first open the valve to the MIN value you have specified.
- SAB07 will not open more than the MAX value you have specified, which is particularly useful for hydronic balancing.

There is an exception to the set limits. In normal conditions if the internal algorithm calculates that it needs to go beyond the MIN or MAX opennes it will be limited to the value set.
However, if the internal algorithm calculates it needs to completely close the valve it will ignore the MIN limit and completely close the valve (0% openness), no mater what the MIN limit was.

By default SAB07 controls the valve openness from 0% to 100%

Not allowed to set values that result in Min - Max < 10%.

SET

The desired range in percentage.	
Byte index	**Hex value – Meaning**
0	4F – The command code.
1	XX – 100 – Maximum valve openness in %. Default is 0x00
2	YY – 100 -Minimum valve openness in %. Default is 0x64

You have to deduct the desired value from 100!

Meaning, if you want to set the range between min 20% and max 60%, you have to compose the command as follows:

1) MAX: 100 - 60% = 40 [dec] or 0x28 [hex]

2) MIN: 100 - 20% = 80 [dec] or 0x50 [hex]

Full command would be 4F2850.

Another example - min 15%, max 90%

1) MAX: 100 - 90 = 10[dec] or 0x0A [hex]
2) MIN: 100 - 15 = 85[dec] or 0x55 [hex]

Full command would be 4F0A55

GET

This command gets the openness range to which the valve can be opened.

Byte index	Sent request	Received response
0	50 – Command code.	50 – The command code.
1		XX - Maximum effective openness parameter.
2		YY - Minimum effective openness parameter.

Example response: 0x500064
Max openness [%] = 100-XX [DEC]
Min openness [%] = 100-YY [DEC]
XX = 00[HEX] = 00[DEC] => Max openness = 100-0 =100%
YY = 64[HEX] = 100[DEC] => Min openness = 0%

»SET MOTOR POSITION AND UPDATE TARGET TEMPERATURE COMMAND EXPLANATION

In the table below is described the data which the server sends to SAB07 to set new target temperature and new motor position.

Byte index	Hex value – Meaning
0	31 – The command will set SAB07 motor position and target temperature
1	XX – Motor position in steps – MSB
2	XX – Motor position in steps – LSB
3	XX – Target temperature to be shown on the LED display when the rotary encoder is moved. Currently 0x05 <= XX <= 0x1E

Example command: 0x31012C1D – Set SAB07 motor position to 300 and target temperature to 29.

When moving the valve, make sure the difference between the current motor position and the desired motor position is >= 17 steps! If you specify a lower amount of steps, the device will misbehave!

»SET MOTOR POSITION ONLY

This command is used to set desired motor position. It can be used when the temperature control is managed by the server. The allowed motor position to set is limited internally to 800 steps (0x0320).

Byte index	Hex value – Meaning
0	2D – The command code.
1	XX – Motor position in steps - MSB.
2	XX – Motor position in steps – LSB.

Example command, [Hex]: 0x2D01F4 – Set the motor position to 500 steps.

When moving the valve, make sure the difference between the current motor position and the desired motor position is >= 17 steps! If you specify a lower amount of steps, the device will misbehave!

4.8. Recalibrate motor command explanation

This command calibrates the device motor and closes the valve (drives the motor to maximum available position). Usage of this command must be avoided. The only data sent from the server is the command code.

Byte index	Hex value – Meaning
0	03 – The command will cause SAB07 to recalibrate the motor

Example command: 0x03

4.9. Read device hardware and software version command explanation.

The server sends the command code to the device and with the next received message the response is received.

Byte index	Hex value – Meaning
0	04 – Read software and hardware version

Example command: 0x04

The device response is described below.

Byte index	Bit Index	Hex value – Meaning
0	-	04 – The command byte shows that is packet with the device hardware and software version.
1	7:4	X – Device primary hardware version.
	3:0	X – Device secondary hardware version.
2	7:4	X – Device primary software version.
	3:0	X – Device secondary software version.

Example response: 0x041242 (Here the received keep-alive command data is omitted for clarity).

Byte index	Bit Index	Hex value – Meaning
0	-	04 – The command byte shows that is packet with the device hardware and software version.
1	7:4	X – Device primary hardware version.
1	3:0	X – Device secondary hardware version.
2	7:4	X – Device primary software version.
2	3:0	X – Device secondary software version.

Decoding:

- 0x04 – Read software and hardware version response
- 0x12 - Device hardware version – version 1.2
- 0x42 – Device software version – version 4.2

4.10. Open window detection

The open window detection function works by looking for a sudden drop in temperature. Therefore, it's not 100% reliable and can be affected by outdoor temperature, position of the device on the radiator, position of the radiator on the room and more factors.

»OPEN WINDOW COMMANDS WITH DELTA T 0.1 ACCURACY

SET

open window detection parameters (0.1 accuracy)

To detect open window, the difference between the currently and previously measured temperatures must be equal or greater than specified temperature difference. New temperature value is got each minute.

Byte index	Bit Index	Hex value – Meaning
0	-	45 – The command will set SAB07 open window detection parameters.
1	7:1	Reserved.
1	0	1 – Enables the open window detection functionality. 0 – Disable (default).
2	-	XX – Duration for the valve to stay closed after open window detection. Resolution – 5 minutes. **(Default value:10 minutes).**
3	-	XX – Temperature difference to detect open window detection (In Celsius degrees), pre-multiplied by 10. **(Default value: 1.0 Celsius)**

Example downlink: 0x4501060D – Enable open window detection; set the duration for the valve to be closed to 30min; set the temperature delta to 1.3°C.

GET

Open window detection parameters (0.1 accuracy)

This command is used to get SAB07 open window detection parameters. Server sends the command code and the response is sent from SAB07 together with the next keep-alive command.

Byte index	Sent request	Received response
0	46 – Command code.	13 – The command code.
1		Bits [7:1] - Reserved
		Bit 8: Open window detection enable/disable bit • 1: Open window functionality is enabled; 0: Open window functionality is disabled.
2		XX – duration for the valve to be at the desired position, after open window detection. Resolution – 5 minutes. (**Default value: 2, meaning 10 minutes)**
3		XX - Temperature delta with resolution 0.1 Celsius degrees. Value is premultiplied by 10.

Example downlink sent by the server: 0x46;

Example command response: 0x4601020F - Enable the open-window detection, duration is 10 minutes, delta is 0x0F = 15/10 = 1.5 degrees Celsius

4.11. Child lock

SET

child lock parameters command explanation.

When child lock is enabled, manual target temperature change with the device rotary encoder is forbidden. If the user rotates the rotary encoder, in case Child lock is enabled, on the device LED display “Ch” is shown. In Table 10 is described the data which the server sends to control this functionality.

Byte index	Hex value – Meaning
0	07 – The command code.
1	XX – 01 to enable and 00 to disable child lock functionality.

Example command: 0x0701 – Enable child lock.

GET

child lock parameters command explanation

This command is used to get SAB07 child lock functional state. Server sends the command code and the response is sent from SAB07 together with the next keep-alive command. The sent command request and the received command response are described in Table 21. The keep-alive in the response is omitted for clarity.

Byte index	Sent request	Received response
0	14 – Command code.	14 – The command code.
1		01 – child lock functionality is enabled; 00 – child lock functionality is disabled;

Example command sent from server: 0x14;
Example command response: 0x1400 – Child lock functionality is disabled.

» CHILD LOCK BEHAVIOR WHEN DEVICE GOES OFFLINE

You can choose what happens with the Child lock setting if a device goes offline for some reason (e.g. gateway is offline). Once the device comes back online, it'll revert to the previously set settings.

E.g. If child lock is activated on a device and it goes offline, you can decide whether the child lock is disabled. Once the device comes back online, it'll revert to the settings that were active prior to going offline.

SET

Byte index	Hex value – Meaning
0	35 - Command code
1	00 – Child lock is automatically disabled when the device goes offline. 01 – Child lock remains unchanged when the device goes offline.

GET

Byte index	Sent request	Received response
0	34 – Command code.	34 – The command code.
1		00 – When child lock is enabled and the device goes offline, child lock will be automatically disabled. (default) 01 – Child lock remains unchanged when the device goes offline.

4.12. Target temperature ranges

»TEMPERATURE RANGES GET/SET COMMANDS EXPLANATION

SET

temperature ranges command explanation.

This command is used to set the possible min. and max. target temperature values.

Byte index	Hex value – Meaning
0	08 – The command code.
1	XX – lower temperature limit. Min. allowed/Default value: 0x05 (5 Celsius degrees).
2	XX – upper temperature limit. Max. allowed/Default value: 0x1E (30 Celsius degrees).

Example command: 0x081018 – Sets the lower temp. limit to 16 Celsius degrees and the upper temp. limit to 24 Celsius degrees.

GET

temperature ranges command explanation

This command is used to get SAB07 possible min. and max. target temperature values. Server sends the command code and the response is sent from SAB07 together with the next keep-alive command. The keep-alive in the response is omitted for clarity.

Byte index	Sent request	Received response
0	15 – Command code.	15 – The command code.
1		XX – Lower temperature limit in Celsius degrees.
2		XX – Upper temperature limit in Celsius degrees.

Example command sent from server: 0x15;
Example command response: 0x15051E – The lower temp. limit is 5°C and the upper temperature limit is 30°C.

4.13. Force-close & Force-attach

»VALVE CLOSE UNTIL OVER-VOLTAGE IS DETECTED COMMAND EXPLANATION (“FORCE CLOSE”)

Usage of this command must be avoided. Sending the command from the server causes the valve to be closed until over-voltage is detected from the device.

Byte index	Hex value – Meaning
0	0B – The command code.

Example command: 0x0B

4.14. Network-related settings

»NETWORK JOIN RETRY PERIOD

SET

network join retry period command explanation.

This command is used to set the period (T) of LoRaWAN join request sending from SAB07, in case it was unable to join the network from the first attempt.

Byte index	Hex value – Meaning
0	10 – The command code.
1	T,[s]=XX∗5. Value 0x00 isn't applicable. Default value: 10 minutes

Example command: 0x10F0 – the server sets SAB07 LoRaWAN join request send period to 20 minutes.

Notes:
This join retry period (T) must comply to LoRaWAN messages duty cycle. Otherwise the join request will be sent on the next attempt. In most of cases, min. acceptable value for T is 240s. Recommended are higher values, for less battery discharge, e.g. 480s;

- This join retry period (T) is for the first 15 sent messages. After, the used LoRaWAN stack automatically changes the possibility to send join request to ~20 minutes for 20 network join attempts. If the device is still not joined to the network after these 20 attempts, next join request can be sent after ~3 hours and 15 minutes.

GET

network join retry period command explanation

This command is used to get the period (T) of LoRaWAN join request sending from SAB07, in case it was unable to join the network from the first attempt. Server sends the command code and the response is sent from SAB07 together with the next keep-alive command.

Byte index	Sent request	Received response
0	19 – Command code.	19 – The command code.
1		XX – Network join retry period value. T,[s]=XX∗5

Example command sent from server: 0x19;
Example command response: 0x19C6 => T = 0xC6*5 = 198*5 = 990s = 16.5 minutes.

»DEVICE RADIO COMMUNICATION WATCH-DOG PARAMETERS

SET

device radio communication watch-dog parameters command explanation	
This command is used to set independent SAB07 radio watch-dog configurations for confirmed and unconfirmed uplink messages sent from the device. It other words, the radio watch-dog configuration for confirmed uplinks no matter when the device works with unconfirmed uplinks, and vice versa. When no downlink is received for the defined Watch-Dog Period (WDP), the device resets itself. The command is described in Table 28. The keep-alive in the response is omitted for clarity.	
Byte index	**Hex value – Meaning**
0	1C – The command code.
1	XX – Watch-dog period (WDP) when confirmed uplinks are used by the device. XX defines how many uplinks should be received without ack so that the device restarts. On top of that XX uplinks, another 7 minutes should pass before the device restarts. *Default value for XX: 0x02.* Note that value 0x00 disables the watch-dog functionality when confirmed uplinks are used.
2	XX – Watch-dog period (WDP) when unconfirmed uplinks are used by the device. Value is represented in hours. *Default value for XX: 0x18. (24 hours)* Note that value 0x00 disables the watch-dog functionality when unconfirmed uplinks are used.

Example command, [Hex]: 1C0300 – Assuming that the send Keep-alive period is 5 minutes, = 22 minutes, but the watch-dog functionality for unconfirmed messages is totally disabled.

GET

device radio communication watch-dog parameters command explanation This command is used to get the radio watch-dog configurations. The command is described in Table 29. The keep-alive in the response is omitted for clarity.		
Byte index	**Sent request**	**Received response**
0	1D – Command code.	1D – The command code.
1		*WDPconfirmed* value, as described in Table 28.
2		*WDPunconfirmed* value, as described in Table 28.

4.15. Remote reset the device

The command forces the device to fully reset (not reverting to factory settings), triggering recalibration as well as joining the network.

Byte index	**Sent request**
0	30 – Command code.

4.16. Freeze Protection

When device is in mode “Manual control” or “Automatic temperature control with external temperature reading” anti-freeze logic will be activated if the built-in temperature & humidity sensor senses below 6°C.

- Device mode is automatically changed to “Automatic temperature control”.
- Device target temperature is set to 7°C.

If the internally measured temperature becomes higher than 9°C, the anti-freeze logic is deactivated.

- Device mode is restored to the one used before the anti-freeze condition.
- Device target temperature is restored to the value before the anti-freeze condition.