

Vicki LoRaWAN

Device communication protocol

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1 Communication concepts

1.1 Communication concepts related to LoRaWAN standard.

- Supported LoRaWAN MAC protocol version: 1.0.3;
- Supported LoRaWAN device class: A;
- LoRaWAN MAC Port: Uplink messages: 2. Downlink messages: 1, 2, 4-223;
- Maximum application payload size: Maximum allowed by document “LoRaWAN regional parameters” for DataRate 0 for the given region. In most of the cases this is 51 bytes;
- Consult the document “LoRaWAN regional parameters” for additional technical information (Especially for RX2 window timings);

1.2 Communication concepts related to device operation.

Vicki LoRaWAN device periodically sends messages (keep-alive commands) to the server. The server can then send command to Vicki 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. Vicki can send both confirmed/unconfirmed uplink messages depending on its configuration. We recommend configure Vicki for confirmed uplinks, since they provide message retransmission in case of not acknowledge of the sent message.

When a command is sent to Vicki device, this LoRaWAN message type can be with confirmation (recommended). In this way the server is sure the command is received by the device, by checking the ACK bit from the MAC header of the next received packet. If the server doesn't get a message confirmation, that command must be retransmitted by the server. One sent packet from the server may contain multiple commands for Vicki to optimize communication time. The only restriction is the total number of bytes sent to be less or equal to the allowed application payload size. These sent bytes can combine both multiple write or/and read commands.

If Vicki receives valid command from the server, next uplink sending will be done as soon as possible. In this way the server can check faster the ACK bit, in case of confirmed downlink was received by Vicki, or the requested data or the keep-alive command data.

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

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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 Vicki.

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

Table 1

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.

2 Messages explanation

Command code, [hex]	Command name	Sent from
01	Keep-alive	Vicki
02	Set keep-alive period	Server
03	Recalibrate motor	Server
04	Read device hardware and software version	Server/ Vicki
06	Set open window detection parameters	Server
07	Set child lock parameters	Server
08	Set temperature ranges	Server
0B	Valve close until over-voltage is detected (also called "force close")	Server

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0C	Set internal temperature control algorithm parameters	Server
1A	Set internal temperature control algorithm parameters – Tdiff only	Server
0D	Set device online operational mode	Server
0E	Set device target temperature (Applicable to certain device online operational modes)	Server
0F	External temperature sensor reading (Applicable to certain device online operational modes)	Server
10	Set network join retry period	Server
11	Set uplink messages type	Server
31	Set a motor position and update the target temperature.	Server
12	Get keep-alive period	Server/ Vicki
13	Get open window detection parameters	Server/ Vicki
14	Get child lock parameters	Server/ Vicki
15	Get temperature ranges	Server/ Vicki
16	Get internal temperature control algorithm parameters	Server/ Vicki
17	Get internal temperature control algorithm parameters – Tdiff only	Server/ Vicki
18	Get device online operational mode	Server/ Vicki
19	Get network join retry period	Server/ Vicki
1B	Get uplink messages type	Server/ Vicki
1C	Set device radio communication watch-dog parameters	Server
1D	Get device radio communication watch-dog parameters	Server/ Vicki
1E	Set device primary operational mode	Server
1F	Get device primary operational mode	Server/ Vicki

Table 2

2.1 Keep-alive command explanation

Periodically sent message which contains the most important device data.
The data is described in Table 3.

Byte index	Bit index	Hex value - Meaning
0	-	01 – Keep-alive Command according to Table 2
1	-	XX – Target Temperature set by the rotary encoder. Currently $0x05 \leq XX \leq 0x1E$
2	-	XX – Temperature measured by the device sensor. Temperature, [Celsius degrees] = $(XX * 165) / 256 - 40$
3	-	XX – Relative Humidity measured by the device sensor. Relative Humidity, [%] = $(XX * 100) / 256$
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
	3:0	X – Motor range in steps, bits 11:8
7	7:4	X – Battery voltage. Voltage = $2 + X * 0.1$, [V]
	3	Set to 1 if open window functionality is enabled and such condition is met. Cleared otherwise.
	2	Set to 1 if too high motor current consumption was measured. Cleared otherwise.
	1	Set to 1 if too low motor current consumption was measured. Cleared otherwise.
	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.
	6:0	Reserved.

Table 3

Example keep-alive: 0x011D5A78FA2C01F080

Decoding:

- 0x01 – Command code (according to Table 2). Shows that keep-alive data follows
- 0x1D – Target temperature is 29
- 0x5A – Sensor temperature; $0x5A = 90$; $90 * 165 / 256 - 40 = 18,0078125$ deg. Celsius
- 0x78 – Sensor humidity; $0x78 = 120$; $(120 * 100) / 256 = 46,875$ % relative humidity
- 0xFA2C01 – Byte indexes 4, 5 and 6; Motor position = $0x0FA = 250$; Motor range = $0x12C = 300$;

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- 0xF0 – Battery voltage and status; 0xF = Battery voltage = $2 + 15 \cdot 0,1 = 3,5\text{VDC}$; 0x0 = All status flags are cleared.
- 0x80 – Rotary encoder is disabled (Child Lock is enabled).

Example keep-alive 2: 0x01185C5CDFDF118000

- 0x01 – Command code (according to Table 2). Shows that keep-alive data follows
- 0x18 = Target temperature is 24
- 0x5C = Sensor temperature; 0x5c = 92; $92 \cdot 165/256 - 40 = 19,296875$ deg. Celsius
- 0x5C = Sensor humidity; 0x5c = 92; $92 \cdot 100/256 = 35,9375$ % relative humidity
- 0xDFDF11 = Byte indexes 4, 5 and 6; Motor position = 0x1DF = 479; Motor range = 0x1DF = 479
- 0x80 = Battery voltage and status; 0x8 = Battery voltage = $2 + 8 \cdot 0,1 = 2,8\text{VDC}$; 0x0 = All status flags are cleared.
- 0x00 = Rotary encoder is enabled (Child lock is disabled).

2.2 Keep-alive period set command explanation

Sets the period for the Vicki keep-alive command messages. See table 4 for details.

Byte index	Bit index	Hex value - Meaning
0	-	02 – The command will set Vicki keep-alive period.
1	-	XX – keep-alive period in minutes. Value 0x00 isn't applicable. Default value: 0x03.

Table 4

Example command: 0x020A

The example sets the keep-alive period to 10 minutes.

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

2.3 Recalibrate motor command explanation

This command calibrates the device motor and closes the valve (set 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	Bit index	Hex value - Meaning
0	-	03 – The command will cause Vicki to recalibrate the motor

Table 5

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Example command: 0x03

2.4 Read device hardware and software version command explanation.

The server sends the command code to the device (Table 6) and with the next received message the response is received. The device response is described in Table 7.

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

Table 6

Example command: 0x04

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.

Table 7

Example response: 0x041211 (Here the received keep-alive command data is omitted for clarity).

Decoding:

- 0x04 – Read software and hardware version response
- 0x12 - Device hardware version – version 1.2
- 0x11 – Device software version – version 1.1

2.5 Set motor position and update target temperature command explanation

In Table 8 is described the data which the server sends to Vicki to set new target temperature and new motor position.

Byte index	Bit index	Hex value - Meaning
0	-	31 – The command will set Vicki 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

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Table 8

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

2.6 Set open window detection parameters command explanation.

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. In Table 9 is described the data which the server sends to Vicki to set the open window detection parameters.

Byte index	Bit index	Hex value - Meaning
0	-	06 – The command will set Vicki open window detection parameters.
1	7:1 0	Reserved. 1 – Enables the open window detection functionality. 0 – disable it (Default).
2	-	XX – Duration for the valve to stay closed after open window detection. Resolution – 5 minutes. Default is 10 minutes.
3	-	XX – motor position to be set when open window detected, bits 7:0.
4	7:4 3:0	X – motor position to be set when open window detected, bits 11:8. X – temperature difference to detect open window detection (In Celsius degrees). Default is 2 Celsius.

Table 9

Example command 1: 0x0601041C23 – Enable open window detection; set the duration for the valve to be closed to 20min; set the motor position to 540 steps; set the temperature delta to 3°C.

Example command 2: 0x0600041C23 – Disable open window detection.

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

Table 10

Example command: 0x0701 – Enable child lock.

2.8 Set temperature ranges command explanation.

This command is used to set the possible min. and max. target temperature values. In Table 11 is described the data the server sends to set these values.

Byte index	Bit 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).

Table 11

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

2.9 Valve close until over-voltage is detected command explanation, also called “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. In Table 12 is described the data the server sends.

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

Table 12

Example command: 0x0B

2.10 Set internal temperature control algorithm parameters.

This algorithm is used during device offline mode or specific online modes. Its aim is to move the motor, so the desired temperature is reached. This command must be used carefully and according to the used online temp. control algorithms. Be sure that the default command parameters aren't satisfactory before overwriting them. The following parameters are introduced for ease of command explanation:

- Pfirst/last: Indicate the first motor position change in valve opening direction and the last motor position change in valve closing direction;
- Pnext: Indicate the next motor position change in valve opening/closing direction;
- Talg: The period for motor position change decisions depending on the desired and measured temperatures;

- Tdiff open/close: Temperature difference between the target (T_{target}) and measured ($T_{measured}$) temperatures, to be surpassed, to get decision for valve movement. This parameter is set with separate command for compatibility with older device software versions.

Check [Figure 1](#) for command and entire internal algorithm operation understanding. The example scenario shown on the figure is for heating primary device mode. The algorithm operation is analogical for cooling device primary mode with the only difference that under cooling mode the valve is opened in order to lower the ambient temperature, not to rise it. Check the table below for additional algorithm understanding under different device primary modes.

	Device primary mode	
	Heating	Cooling
Valve opened if	$(T_{target} - T_{measured}) > T_{diff\ open}$	$(T_{target} - T_{measured}) < -T_{diff\ open}$
Valve closed if	$(T_{target} - T_{measured}) < -T_{diff\ close}$	$(T_{target} - T_{measured}) > T_{diff\ close}$

Important note on the algorithm operation.

The implemented temperature control algorithm is compliant with the stepper motor mechanical system. Its mandatory the valve to be opened and later closed with same number of movements per direction. Also, each movement at one of the directions must be with equal number of steps, to the corresponding movement to the other direction. This fashion of motor control is needed, to struggle the loss of generated steps, due to the motor mechanical system backlash. It can be observed at [Figure 1](#).

If Vicki works in mode at which the motor position is set through the server, it's mandatory the server moves the valve with same number of steps, as the internal algorithm (Pfirst/last, Pnext). Also, Pfirst/last/next values less than 16 steps are meaningless.

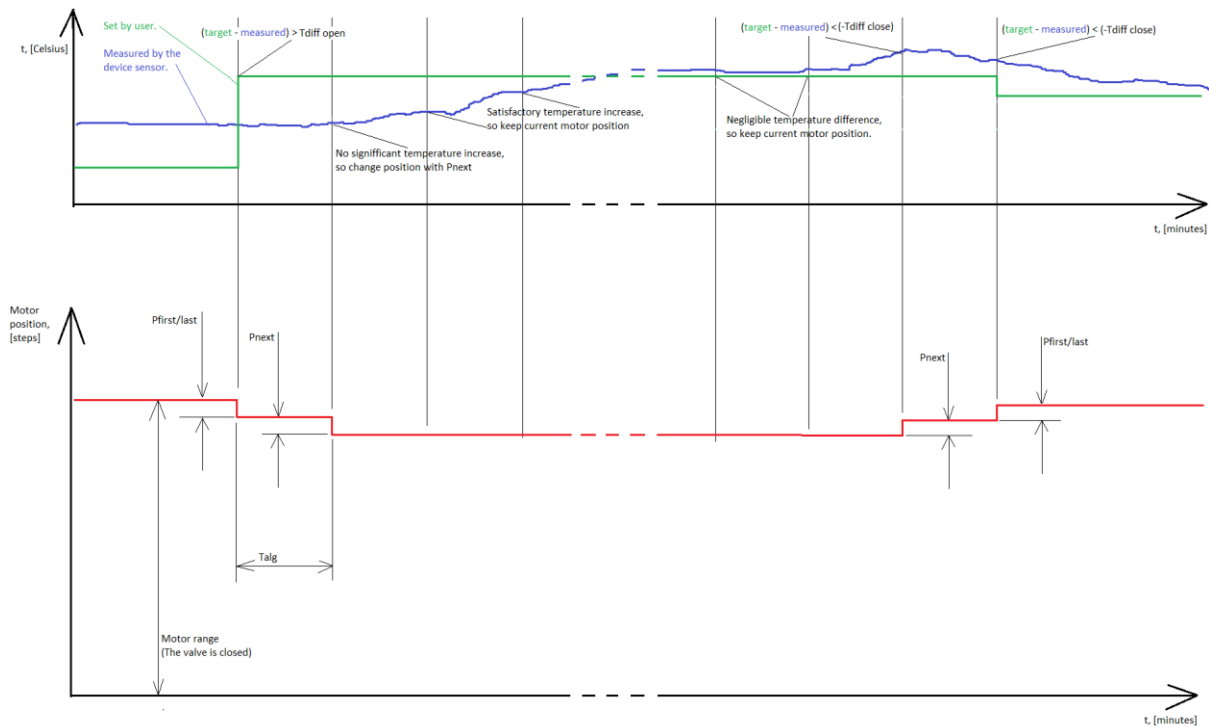


Figure 1

In table 13 is described the command to set the device internal temperature control algorithm parameters, except the Tdiff open/close which is set with separate command.

Byte index	Bit index	Hex value - Meaning
0	-	0C – The command code.
1	-	XX – Internal algorithm temperature check period in minutes – Talg. Default value 20min.
2	-	XX – Internal algorithm first/last opening/closing steps – Pfirst/last. Default value 20 steps.
3	-	XX – Internal algorithm next opening/closing steps – Pnext. Default value 20 steps.

Table 13

Example command: 0x0C131010

With the example command, the internal temperature control algorithm parameters are set as follows: Talg = 19 minutes, Pfirst/last = 16 steps, Pnext = 16steps.

2.11 Set internal temperature control algorithm parameters – Tdiff only.

This command is used to set the Tdiff open/close parameters from [Figure 1](#). In the table below the command data is described.

Byte index	Bit index	Hex value - Meaning
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0	-	1A – The command code.
1	-	XX – Tdiff open value, [°C]. The resolution is 1°C. Default value is 0x01 (1°C). Value 0x00 is allowed.
2	-	XX – Tdiff close value, [°C]. The resolution is 1°C. Default value is 0x01 (1°C). Value 0x00 is allowed.

Example command: 0x1A0201

With the example command, Tdiff open is set to 2°C and Tdiff close is set to 1°C.

2.12 Set device operational mode command explanation

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 its internal temperature control algorithm to achieve target temperature;
- **Online manual control** – device is connected to the network; internal temperature control algorithm is disabled. Motor position is determined by the server. Default online mode.
- **Online automatic control** – device is connected to the network; internal temperature control algorithm is enabled; Target temperature is determined by the server.
- **Online automatic control with external temperature reading** – device is connected to the network; internal temperature control algorithm is enabled; internal temperature sensor is disabled; Target temperature and sensor reading is determined by the server.

With this command the online mode can be selected. 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. In Table 14 is described the command to set the desired device online mode.

Byte index	Bit index	Hex value - Meaning
0	-	0D – The command code.
1	-	00 – Online manual control mode. Default for the device; 01 – Online automatic control mode; 02 – Online automatic control mode with external temperature reading.

Table 14

Example command: 0x0D01

With the example command, online automatic control mode is chosen.

2.13 Set device target temperature command explanation.

This command is applicable for the device when it is 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 Table 15.

Byte index	Bit 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).

Table 15

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

2.14 External temperature sensor reading command explanation.

This command is applicable when the device is in online automatic control mode with external temperature reading. The server sends this command to Vicki device when it has a new measured temperature by the external sensor. This external temperature will be used by Vicki for the internal temperature control algorithm. The command is described in details in Table 16.

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

Table 16

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

2.15 Set network join retry period command explanation.

This command is used to set the period (T) of LoRaWAN join request sending from Vicki, in case it was unable to join the network from the first attempt. The command is described in Table 17.

Byte index	Bit index	Hex value - Meaning
0	-	10 – The command code.
1	-	T, [s] = XX * 5. Value 0x00 isn't applicable. Default value: 3 minutes.

Table 17

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

Notes to this command:

- 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.

2.16 Set uplink messages type command explanation.

This command is used to set Vicki sent uplink message type. The command is described in Table 18.

Byte index	Bit index	Hex value – Meaning
0	-	11 – The command code.
1	-	00 – Vicki sends unconfirmed uplink messages; 01 – Vicki sends confirmed uplink messages. Default message type for the device

Table 18

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

2.17 Get keep-alive period command explanation

This command is used to get Vicki period of the keep-alive command messages. Server sends the command code and the response is sent from Vicki together with the next keep-alive command. The sent command request and the received command response are described in Table 19. The keep-alive in the response is omitted for clarity.

Byte index	Bit index	Hex value – Meaning	
		Sent request	Received response
0	-	12 – The command code.	12 – The command code.
1	-		XX – device keep-alive period in minutes.

Table 19

Example command sent from server: 0x12;

Example command response: 0x1209 – Vicki keep-alive is 9 minutes.

2.18 Get open window detection parameters command explanation

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

keep-alive command. The sent command request and the received command response are described in Table 20. The keep-alive in the response is omitted for clarity.

Byte index	Bit index	Hex value – Meaning	
		Sent request	Received response
0	-	13 – Command code.	13 – The command code.
1	7:1 0		Reserved; 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.
3	-		XX – motor position to set when open window detected, bits 7:0.
4 4	7:4 3:0		X – motor position to set when open window detected, bits 11:8. X – temperature difference to detect open window detection (In Celsius degrees).

Table 20

Example command sent from server: 0x13;

Example command response 1: 0x130102F412 – Open window detection functionality is enabled. When open window is detected, the motor will stay for 10 minutes on the specified position. Desired motor position is 500 steps. Open window will be detected when the temperature difference between the previously and currently measured temperatures become 2°C or greater.

Example command response 2: 0x130002F412 – Open window detection functionality is disabled.

2.19 Get child lock parameters command explanation

This command is used to get Vicki child lock functional state. Server sends the command code and the response is sent from Vicki 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	Bit index	Hex value – Meaning	
		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;

Table 21

Example command sent from server: 0x14;

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Example command response: 0x1400 – Child lock functionality is disabled.

2.20 Get temperature ranges command explanation

This command is used to get Vicki possible min. and max. target temperature values. Server sends the command code and the response is sent from Vicki together with the next keep-alive command. The sent command request and the received command response are described in Table 22. The keep-alive in the response is omitted for clarity.

Byte index	Bit index	Hex value – Meaning	
		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.

Table 22

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.

2.21 Get internal temperature control algorithm parameters

This command is used to get Vicki internal temperature control alg. parameters from [Figure 1](#), except Tdiff open/close. Server sends the command code and the response is sent from Vicki together with the next keep-alive command. The sent command request and the received command response are described in Table 23. The keep-alive in the response is omitted for clarity.

Byte index	Bit index	Hex value – Meaning	
		Sent request	Received response
0	-	16 – Command code.	16 – The command code.
1	-		XX – Internal algorithm temperature check period in minutes – Talg.
2	-		XX – Internal algorithm first/last opening/closing steps – Pfirst/last.
3			XX – Internal algorithm next opening/closing steps – Pnext.

Table 23

Example command sent from server: 0x16;

Example command response: 0x16141010 – Talg=20 minutes, Pfirst/last=16 steps, Pnext=16 steps.

2.22 Get internal temperature control algorithm parameters – Tdiff only

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This command is used to get Vicki internal temperature control alg. parameters Tdiff open/close from [Figure 1](#). Server sends the command code and the response is sent from Vicki together with the next keep-alive command. The sent command request and the received command response are described in Table 24. The keep-alive in the response is omitted for clarity.

Byte index	Bit index	Hex value – Meaning	
		Sent request	Received response
0	-	17 – Command code.	17 – The command code.
1	-		XX – Tdiff open value, [°C]. The resolution is 1°C.
2	-		XX – Tdiff close value, [°C]. The resolution is 1°C.

Table 24

Example command sent from server: 0x17;

Example command response: 0x170201 – Tdiff open=2°C, Tdiff close=1°C.

2.23 Get device operational mode command explanation

This command is used to get Vicki online operational mode. Server sends the command code and the response is sent from Vicki together with the next keep-alive command. The sent command request and the received command response are described in Table 25. The keep-alive in the response is omitted for clarity.

Byte index	Bit index	Hex value – Meaning	
		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.

Table 25

Example command sent from server: 0x18;

Example command response: 0x1801 – Vicki works in online automatic control mode.

2.24 Get network join retry period command explanation

This command is used to get the period (T) of LoRaWAN join request sending from Vicki, in case it was unable to join the network from the first attempt. Server sends the command code and the response is sent from Vicki together with the next keep-alive command. The sent command request and the received command response are described in Table 26. The keep-alive in the response is omitted for clarity.

Byte index	Bit index	Hex value – Meaning	
		Sent request	Received response

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0	-	19 – Command code.	19 – The command code.
1	-		XX – Network join retry period value. $T, [s] = XX * 5$.

Table 26

Example command sent from server: 0x19;

Example command response: 0x19C6 => $T = 0xC6 * 5 = 198 * 5 = 990s = 16.5$ minutes.

2.25 Get uplink messages type command explanation

This command is used to get Vicki sent uplink messages type. Server sends the command code and the response is sent from Vicki together with the next keep-alive command. The sent command request and the received command response are described in Table 27. The keep-alive in the response is omitted for clarity.

Byte index	Bit index	Hex value – Meaning	
		Sent request	Received response
0	-	1B – Command code.	1B – The command code.
1	-		00 – Vicki uplinks are unconfirmed; 01 – Vicki uplinks are confirmed.

Table 27

Example command sent from server: 0x1B;

Example command response: 0x1B00 => Vicki sent uplinks are unconfirmed.

2.26 Set device radio communication watch-dog parameters command explanation

This command is used to set independent Vicki radio watch-dog configurations for confirmed and unconfirmed uplink messages sent from the device. In 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	Bit index	Hex value – Meaning
0	-	1C – The command code.
1	-	XX – Watch-dog period (WDP) when confirmed uplinks are used by the device. $WDP_{confirmed}, [min] = XX * (Keep - alive\ period, [min]) + 7$ 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. $WDP_{unconfirmed}, [min] = XX * 60$ Default value for XX: 0x18. Note that value 0x00 disables the watch-dog functionality when unconfirmed

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	uplinks are used.
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Table 28

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

2.27 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	Bit index	Hex value – Meaning	
		Sent request	Received response
0	-	1D – Command code.	1D – The command code.
1	-		$WDP_{confirmed}$ value, as described in Table 28.
2	-		$WDP_{unconfirmed}$ value, as described in Table 28.

Table 29

2.28 Set device primary operational mode

This command is used to change the device primary operational mode. Possible choices are heating (default for the device) and cooling. Switching from heating to cooling mode is required, when during the summer, cold water flow through the radiator. At the cold radiator water period end, switch to heating mode is required. Note that for both modes device functionalities open window detection and internal temperature control algorithm are available. The command data is described in Table 30. The keep-alive in the response is omitted for clarity.

Byte index	Bit index	Hex value – Meaning
0	-	1E – The command code.
1	-	00 – Vicki operates in heating mode (default for the device); 01 – Vicki operates in cooling mode.

Table 30

2.29 Get device primary operational mode

The command is described in Table 31. The keep-alive in the response is omitted for clarity.

Byte index	Bit index	Hex value – Meaning	
		Sent request	Received response
0	-	1F – Command code.	1F – The command code.
1	-		00 – Device primary operational mode is heating; 01 – Device primary operational mode is cooling.

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Table 31

3 Appendix

3.1 Command examples.

Example containing more than 1 command for sent/received server packet uses alternate colors for each command (and optional command data) for ease of understanding.

3.1.1 Command example 1

This example shows sent and received server message. The sent message contains 2 commands for Vicki:

- Read software and hardware version (Command code 0x04);
- Set motor position to 300 steps and display digits/target temperature to 29 Celsius degrees (Command code 0x31).

The next received server message will contain also 2 commands from Vicki:

- The response to command code 0x04;
- The standard periodically sent keep-alive command with its data.

Server sends, [hex]: 0431012C1D.

Server receives, [hex]: 042321011D5A78FA2C01F080.

3.1.2 Command example 2

This example shows server packet which consists of 7 Vicki commands:

- Set keep-alive period (Command code 0x02) to 11 minutes;
- Set temperature ranges (Command code 0x08) to 15 and 26 Celsius degrees;
- Set device operational mode (Command code 0x0D) to online automatic control;
- Set target temperature (Command code 0x0E) to 24 Celsius degrees.
- Get keep-alive period (Command code 0x12);
- Get temperature ranges (Command code 0x15);
- Get device operational mode (Command code 0x18).

Server sends, [hex]: 020B080F1A0D010E18121518.

With the next keep-alive the server will receive and the requested data from Vicki:

Server receives, [hex]: 120B150F1A1801011863530000008000.

4 Revision history.

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Date	Version	Author	Comment
7 May 2020	V1.0	Martin Peevski	Initial draft
8 May 2020	V1.1	Milan Stefanov & Lyubomir Yanchev	<ul style="list-style-type: none"> – Document review; – Message examples inclusion.
20 May 2020	V1.2	Martin Peevski	Added general information and more supported commands.
20 May 2020	V1.3	Milan Stefanov & Lyubomir Yanchev	Document review and visual edits.
27 May 2020	V1.4	Lyubomir Yanchev	Document general formatting.
15 June 2020	V1.5	Martin Peevski	All chapters updated; Added support to read all commands parameters (GET commands).
11 August 2020	V1.6	Martin Peevski	<ul style="list-style-type: none"> – Chapters 1.1, 2.2, 2.16 updated; – Added new commands (chapters 2.26, 2.27).
28 Sep. 2020	V1.7	Martin Peevski	<ul style="list-style-type: none"> – Updated chapters 2.10, 2.11, 2.21, 2.22; – Added new commands (chapter 2.28, 2.29).

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